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RADIO AND HOBBIES IN AUST

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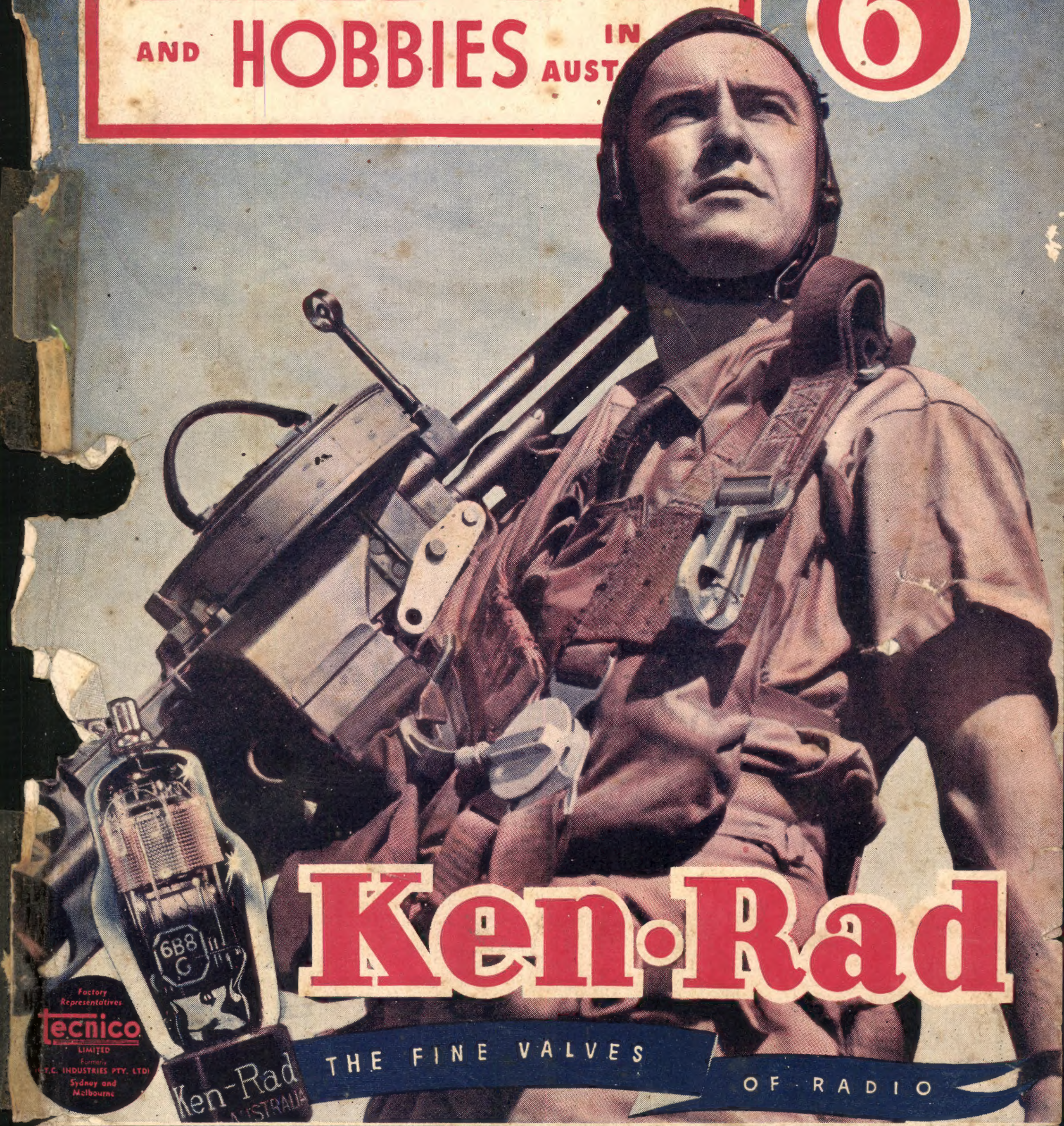

R. & H. ALL-WAVE BATTERY THREE

RADIO AND HOBBIES IN AUSTRALIA

ELECTRONICS IN INDUSTRY

DURING recent months, American radio magazines have been devoting a lot of space to the subject of electronic devices and their application in industry. Apparently the magazines concerned, and those dealers and servicemen still in regular business, are working hard to make American industrialists electronic minded.

As a natural outcome, electronic devices are being installed in ever-increasing numbers, and are being put to a bewildering array of tasks.

The old publicity gag of having doors and gates open and close of their own accord is saving the time and patience of factory hands and drivers handling heavy loads. Along similar lines are devices to protect the operators of presses and other machines, on which purely mechanical safety guards would be time-wasting or impracticable.

At the end of the assembly line, electronic devices sort and grade articles as they pass by on conveyor belts. Once set, the devices operate without attention counting and passing the items which conform to standard, diverting those which do not. By means of a bank of lights and phototubes, every inch of certain fabrics are examined as they come off the machines; any break in the texture causes signal lights or warning bells to operate.

Color matching, turbidity measurement, moisture detection, heat and welding control, are just a few of the many applications. In general, the mechanical problems involved are not formidable and the electrical apparatus is no more complicated than the average radio receiver.

On a larger scale, short-wave therapy is finding many industrial applications, and replacing more cumbersome oven-heating methods. Typical tasks are the drying out of tobacco leaf and the drying out of newly manufactured plywoods. Such non-conducting materials are heated uniformly throughout, and the heating necessarily ceases when all moisture has been removed. The drying out process is simplified and speeded up and is made virtually foolproof.

Outside the war factories, phototube circuits and acoustic fences keep a twenty-four hour watch against intruders. Let smoke appear in the ventilation system and immediately an alarm bell rings a warning. Let the street lights go out and a phototube circuit will immediately black out all exterior lighting.

Every device used means that the whole or a proportion of somebody's time is saved. Taking a wide view of industry, the potential saving in manpower must be impressive.

Comparable development in Australia of electronic devices has been and is limited by the pitifully inadequate stocks of suitable special-purpose tubes. Consideration of shipping space, of exchange and supply are all involved, but a more active exploitation of electronic devices in Australian factories could not help but result in some economics in our sadly strained manpower resources.

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This month your "Radio & Hobbies" has fewer pages as a result of wartime conditions. However, certain features have been streamlined and a more compact type used throughout. These changes, coupled with the limited amount of advertising, mean that there is practically no reduction in the amount of reading matter.

W. H. Williams

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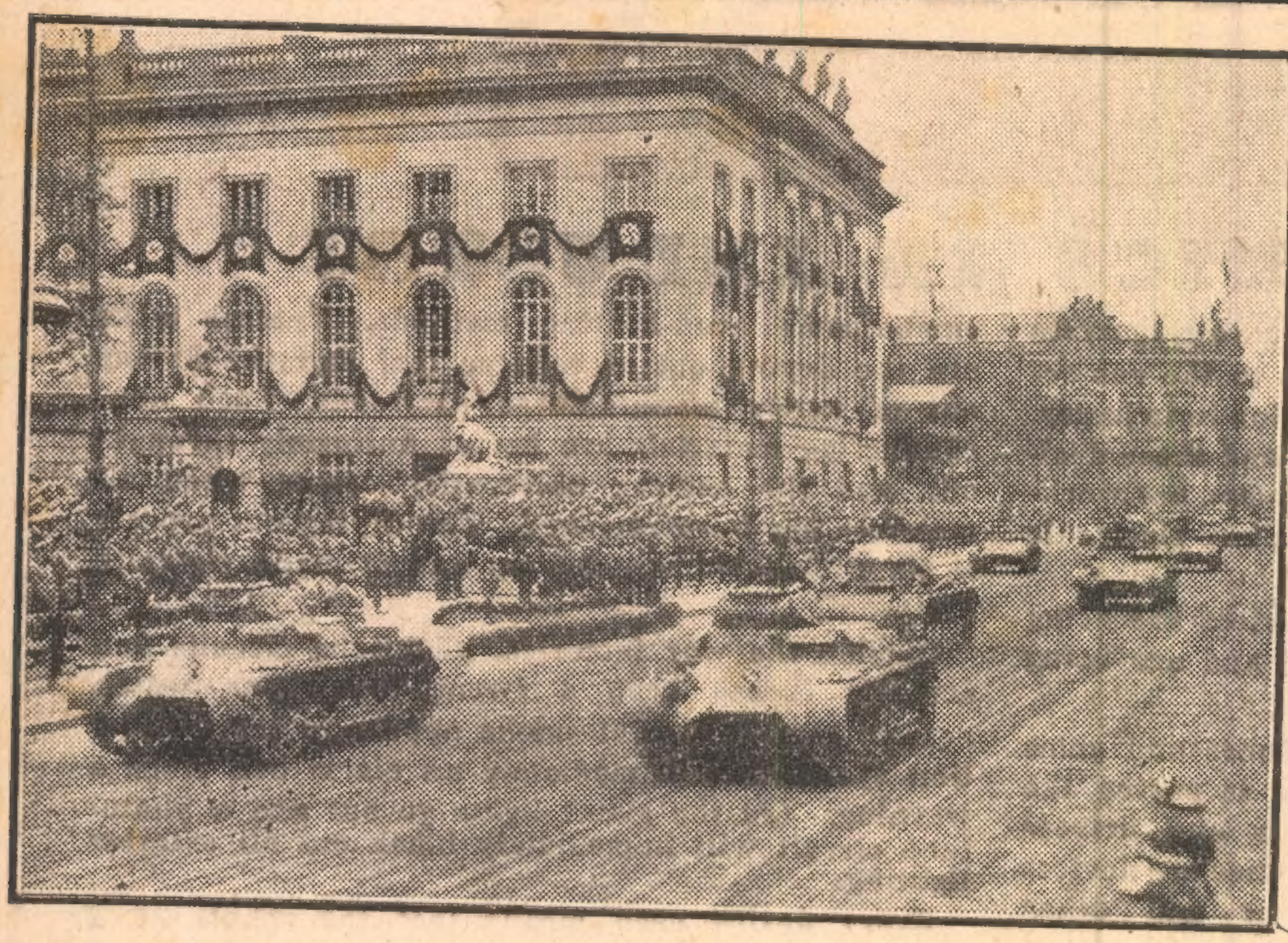
FEATURE STORY

THE STORY OF POWDERED METALLURGY



In six short years Germany built up a striking force which very nearly succeeded in winning for her a quick victory. In the rapid production of tanks and planes Krupp interests made full use of tungsten carbide and similar materials for cutting tools.

Ever since Hitler's steel-clad legions crushed Poland in 1939 and France in 1940 one German accomplishment—perhaps the greatest of Germany's many—has exercised the minds of both public and technical experts alike. How was practically bankrupt Germany able to build her truly terrific war machine in the six short years between the burning of the Reichstag in 1933 and the outbreak of World War II?

HOW was her limited industrial plant capable of turning out tanks, planes and guns in such numbers as to dwarf the production of the rest of Europe?

The popular answers have been many—the German "will to win," a population strictly regimented into industrial production, the undoubted quality of German technical ingenuity, &c. All these explanations have overlooked the possibility that a few hundred tons of a phenomenal steel-cutting material called tungsten carbide may have been a decisive factor in the building of the arsenal of Hitlerism.

HARDER THAN SAPPHIRE

Harder than sapphire and very nearly as hard as diamond, tungsten carbide was invented in Germany round about 1915, and was taken over by the Krupp interests in 1916. The famous Big Bertha which shelled Paris from a range of 70 miles was tooled with tungsten carbide, and the new material gave Germany a decided advantage over the Allies (who had developed nothing comparable) in armament production.

Part of the magic of tungsten carbide lies in its hardness. Part lies in the fact that it has a melting point of about 2800 degrees centigrade. These two properties make it so far superior to high-speed (tungsten alloy) steel as a cutting edge for machine tools, that there is hardly a basis for comparison.

In many machining operations, substitution of tungsten carbide for high-speed steel multiplies the rate of production at least 500 per cent. And Germany retained unquestioned leadership in the use of tungsten carbide after the Armistice, even though Krupp licensed other producers throughout the world.

Britain, France, and the United States were sluggish about re-tooling, and it is estimated that in 1938 Germany had 20 times as much tungsten carbide in use as Britain. This—according to many experts—is one of the great secrets of German rearmament. These experts also think that without tungsten carbide it would have taken the Reich twice as long to achieve half the results.

Furthermore, fragments of shells picked up on various battlefields indicate that Germany is using tungsten carbide for projectile tips, and even may have developed a superior light-weight armor plate, consisting of thin layers of carbide and steel.

A German refugee, Dr. Paul Schwarzkopf, now working in America, claims to have first invented such plate for the German army during the last war, and has since designed a somewhat similar material, which he has offered to the United States Army.

There is hope that Allied industry will speedily overtake Germany in the use of tungsten carbide, just as once before industry learned all the tricks of the German dye trade in record time. Today, tungsten carbide, tungsten tantalum carbide, tungsten titanium carbide, and tungsten tautalum titanium carbide, known as "hard cemented carbides" or "hard metals," are being produced by five or six factories in both Britain and the United States.

Because of its extremely high melting point, tungsten cannot be melted, cast, or machined like other metals. The only practical way of handling tungsten is in the form of pure metallic powder, the starting point in the process known as "powder metallurgy." Powder metallurgy means the conversion of dust-fine metal particles into finished mechanical forms through pressure and heat, without melting, casting, forging, or any of the processes used for the shaping of other metals.

TWO MAIN APPLICATIONS

The main uses of powder metallurgy can be broadly divided into two groups. First is the working of tungsten and other hard metals, and the creation of certain difficult alloys that are unobtainable by other processes, and are unique in their industrial value. Second, and more recent, is the use of powder metallurgy to produce ordinary machine parts competitively with other methods, or to produce certain specialties that cannot be made by other means.

In many instances parts made by powder metallurgy are better and cheaper than those produced by casting and machining, and the process has the universal advantage of speed.

Manufacture by the second process gives a startling demonstration of the use of powder metallurgy. The starting point is a pile of grey dust, consisting of pure iron powder thoroughly mixed with graphite, or copper, both in proportions measured with the most exquisite precision. A few ounces of the dust is poured into a hardened steel die set in the table of a hydraulic press, and top and bottom plungers come together with the force of some 50,000 pounds per square inch.

SINTERING PROCESS

When they withdraw, the grey dust of a moment ago is now a perfectly shaped small gear. This is strong enough to be handled, though it would break if

by L. B. Montague

NEW TECHNIQUE SPEEDS UP PRODUCTION

dropped on the floor. But from the press the gear is carried to an electric furnace and placed on a conveyer belt. For 30 minutes or so it is exposed to a high temperature, in most cases about 25 per cent. below the melting point of the oven (1535 deg. C.).

At the end of this process—called sintering—the scoopful of dust has metamorphosed into a perfect machine part. The gear now has a mechanical strength equal to that of a machined cast-iron gear, and is ready to be installed. It is 25 per cent. lighter than an ordinary gear, and will run more quietly and with less wear. It is stamped out within extremely narrow tolerances, with virtually no waste, whereas a casting or machining operation that involves no more than 30 per cent. waste is considered highly efficient. In gear cutting the waste frequently approaches 70 per cent.

OIL IMPREGNATION

Furthermore, the pressed gear has certain valuable characteristics that cannot be duplicated in a cast piece. For example, on account of the composition of the pressed metal, it can be impregnated with oil and will function almost indefinitely without further lubrication.

Most striking, however, is the production of the finished pressed gear in two simple operations. The old method of casting and tooling starts with the iron ore, reduced to semi-pure metal in blast furnaces—the oxygen is expelled in the form of carbon dioxide by coking. The molten metal is then cast into pigs, but the iron still contains impurities which need further refining to remove. After this further process the iron is cast into cylindrical blanks that weigh 14oz. each.

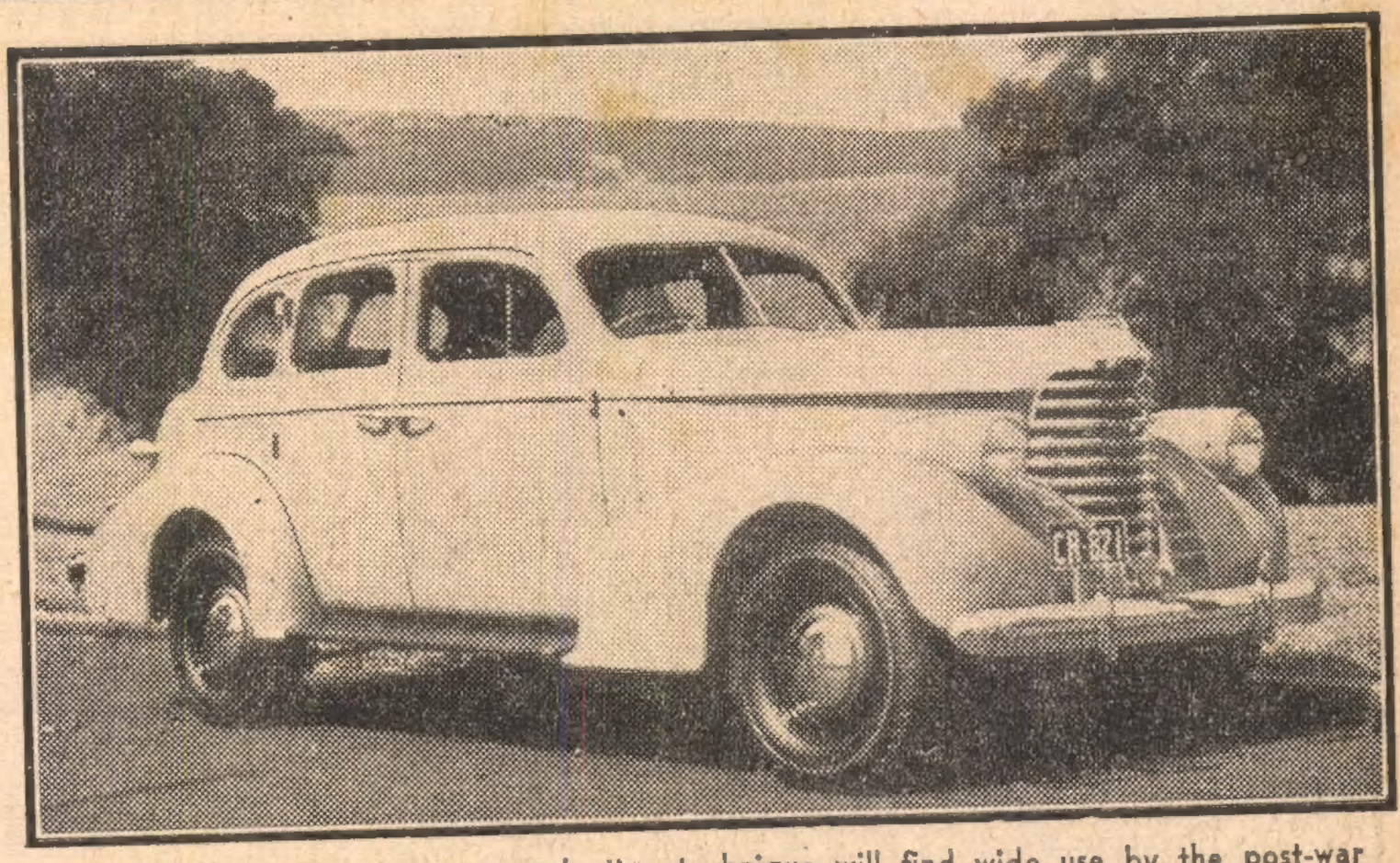
Now the machining starts. The first operation in the making of a small gear is boring a hole through the centre of the iron cylinder. The outside diameter of the cylinder is then reduced to the required size and made concentric with the centre hole. The longest operation, cutting of the gear-teeth, follows, though machining never does gears as perfectly as the pressing method.

DEFINITE ECONOMY

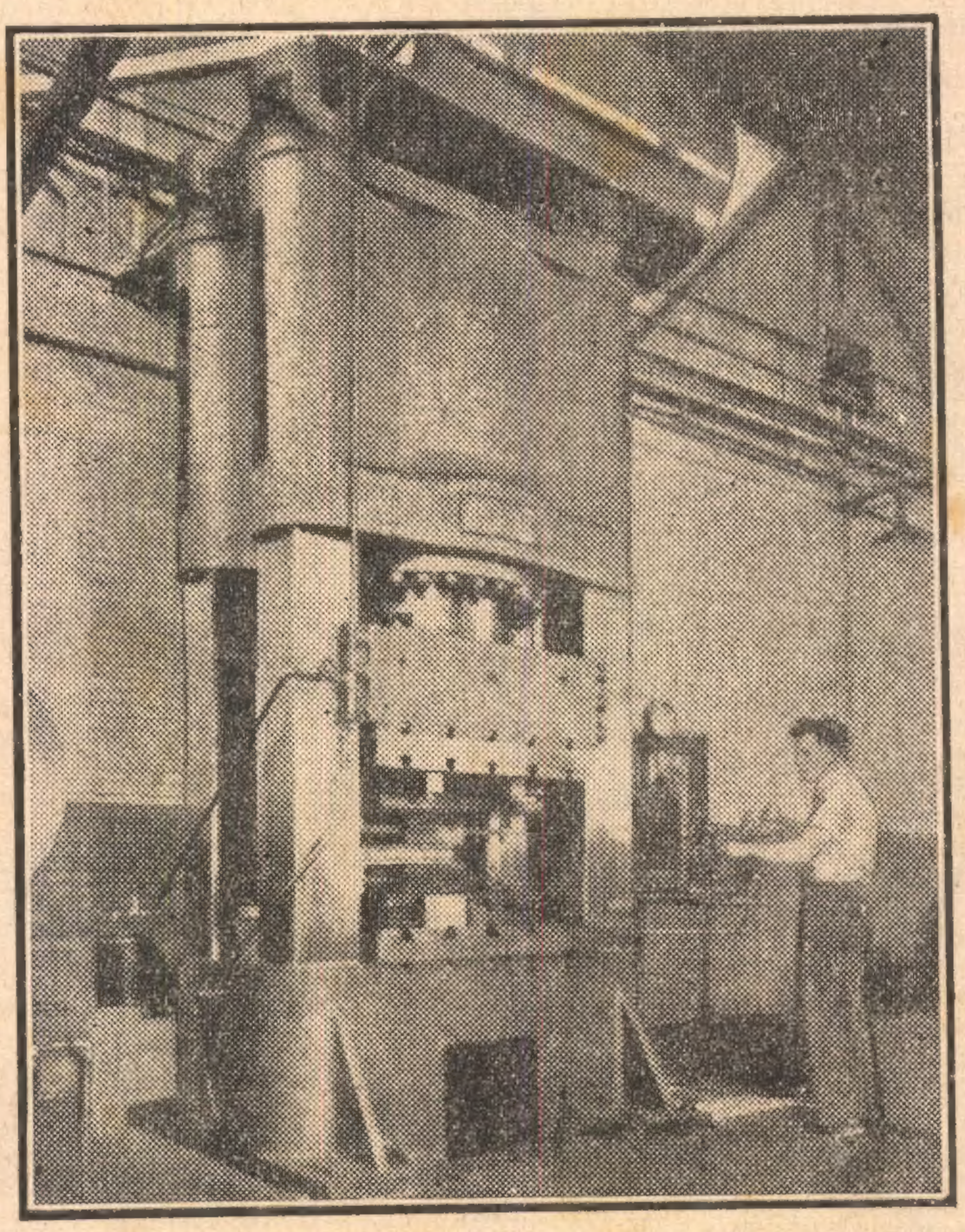
When working to a really fine tolerance, further trimming is needed. The process requires complicated machinery, skilled operators, and perhaps 30 man-hours per 1000 gears at the minimum, as against 15 unskilled man-hours per 1000 for the new process. These factors make the pressed gear cheaper than the machined or cast gear, despite the fact that the raw material—the pressed powder—cost 4d or 5d more per pound than the ingot iron.

The economy of the powder technique relative to casting or machining tends to increase the size of the manufactured part declines. In other words, it is difficult or impossible to make casting moulds for very small magnets, contacts, bearings, and similar tiny parts used in some cameras, radio sets, electric fans, speedometers, &c., and the alternative is machining. But with the new process such parts can be stamped out at high speed with the uniformity of aspirin tablets.

In the United States, in 1941, it is estimated that between 6000 and 7000 tons of powdered metals were used—exclusive of the paint industry—an increase of something like 25 per cent. over 1940, and probably double the consumption five years ago.



It is predicted that the new production technique will find wide use by the post-war automobile industry. So-called "oilless" bearings will be used in door hinges, in locks, and in other positions where normal lubrication methods are unsatisfactory.



A serious limitation of powdered metallurgy is the terrific pressure required as yet to form the parts successfully. Here is a 2000-ton experimental press which has been installed by the General Motors organisation.

Because of the impressive results achieved so far, and the possibilities opening up for the future, powder metallurgy has attracted a group of enthusiasts who describe the art as "the greatest development in metallurgy in the last 500 years," or words to that effect, and who predict that within a decade or so it will completely revolutionise the prevailing techniques of metal working.

Research specialists, engineers and others concerned with practical applications of the process, go along with this prediction only part way, and cautiously look for a gradual evolution and extension of powder metallurgy without expecting any "revolution." For, as will be seen, the process has certain definite limitations.

Nevertheless, 1942 model cars manufactured by Chrysler, General Motors, and Ford contain some two dozen powdered-metal parts, weighing about two pounds altogether (mostly bronze alloy and iron alloy bearings and gears), and the more imaginative powdered metal supporters look to the day when powdered metal weight may be up to an average of 100 pounds per car. At the present time, General Motors is turning out

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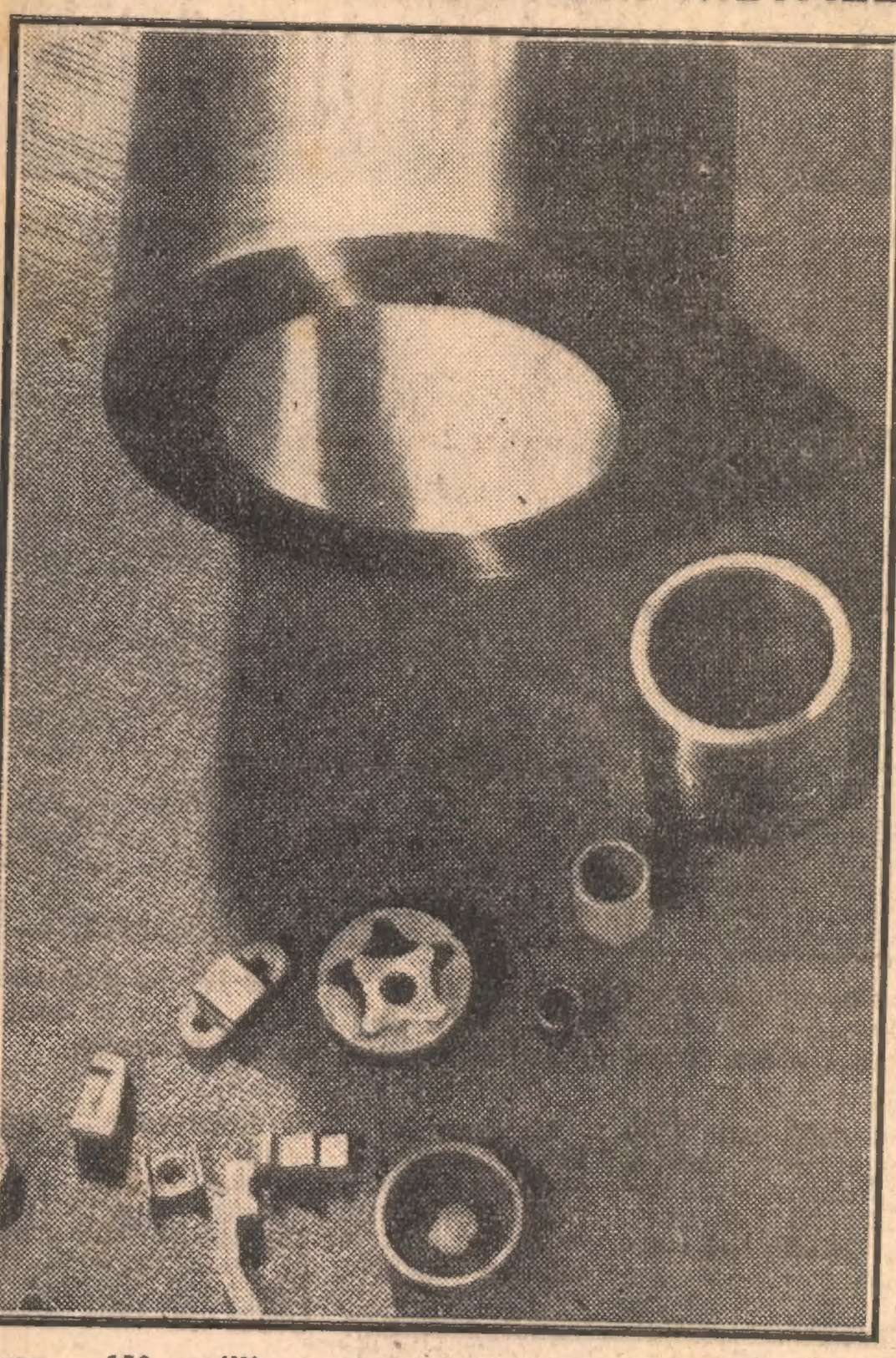
FEATURE STORY

TYPICAL PARTS FROM METALLIC POWDER



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Typical samples of powder metallurgical products. Small items like these can be mass produced very economically. If necessary they can be impregnated with oil so as largely to obviate the necessity for subsequent lubrication. It has been suggested that typewriter keys could be impregnated with ink, thus eliminating the necessity for the usual ink ribbon.

★

over 150 million pieces a year, and Chrysler is using "several hundred pounds of powders" a month.

All of which suggests that powder metallurgy is a "new art," but actually it isn't. It is new only in the sense that the pressures and shortages of the armament plan have forced several industries to experiment with the process as a possible machine and labor-saving short-cut, and thus have brought the science on to the centre of the stage—but not for the first time. As one metallurgist says: "Powder metallurgy is in its infancy—but it isn't young."

CENTURIES OLD

About 5000 years ago—as nearly as archaeologists can estimate—the enterprising Egyptians are believed to have discovered a method of manufacturing useful implements from the iron ore then plentiful in the country.

They knew nothing of the art of casting, and some researchers think they hammered or pressed bits of spongy iron into lumps of workable metal, which were then beaten into shape and heat-treated for strength. Tests of the metal contained in these ancient tools and vessels have indicated that it was never melted.

If these surmises are correct, the Egyptians of 3000 BC had already stumbled on all the essential principles of the modern technique of powder metallurgy. The first "modern" application of the technique occurred more than a century ago, when metallurgists were baffled by the problem of melting platinum.

None of the furnaces of the time were capable of generating the necessary temperature of 1755 degrees C. But certain experimenters, never positively identified, found a way to obtain pure platinum powders, and then pressed the powders into briquettes.

After sintering at temperatures far below the actual melting point of the metal and further pressing, these briquettes became dense enough and strong enough to be machined, and thus the casting process was by-passed.

The same technique was successfully applied to iridium in the last century, but, soon after, the development of better furnaces ended the need for the lengthy powdering, pressing and sintering process, and little further experimentation took place for nearly a hundred years.

A revival of powder metallurgy occurred in the early 1900's for the same fundamental reason that inspired the experiments with platinum. Edison invented the electric lamps, and after endless trial and error hit upon tungsten as the ideal material for filaments. But tungsten could not be melted or cast. So researchers turned back to powder metallurgy and resumed work that had been dropped in the early nineteenth century.

TREATING TUNGSTEN

Pure tungsen powder was finally obtained by reducing tungsten oxide in a furnace in the presence of hydrogen. The powder was then pressed into bars. Next the bars were sintered at comparatively low heat to increase their strength and were given a final high-temperature sintering by having a powerful electric current run through them.

To produce wire, the tungsten bar was brought to white heat in a furnace, and after shaping was drawn through diamond dies. This is substantially the same process used today in the manufacture of all lamp filaments and tungsten and molybdenum wire.

There is, therefore, a degree of truth in the powder metallurgists' claim that the successful application of the sintering process to tungsten "founded the electrical industry."

The next great development was tungsten carbide. Here again production commences with dust-particles of tungsten and carbide (lampblack) mixed with a cobalt binder, frequently with the addition of tantalum or titanium. Under pressures as high as 60,000lb. per square inch, this dust is formed into a solid and is sintered at a temperature of 800 degrees C. or thereabouts.

Still comparatively soft after this preliminary sintering, this material is cut and ground into final shape—which may be anything from a five-shilling half-inch tip for a drill to the record-sized £1250 tantalum tungsten die made for "cold-nosing" 105-millimetre shells.

The forming operation is partly accomplished by another product of powder metallurgy—grinding wheels of pressed bronze impregnated with diamond dust. After the grinding and shaping the piece is given a final sintering at close to 1500 degrees C.

FOR CUTTING TOOLS

As mentioned earlier, the finished product possesses such hardness, durability and heat resistance that it makes an incomparable cutting tool. Tungsten carbide glows cherry red and is usable up to 1200 degrees C. or more—a temperature at which high-speed tool steels begin to soften. In one factory making brake drums, the old steel tools had to be replaced after cutting 150 units, whereas the carbide tools now in operation are good for 950 units.

Similarly, the die produced for cold-nosing shells already has been used for more than 600,000 shells and is expected to pass the million mark before it wears beyond allowable tolerances. Furthermore, not one of the shells nosed by this die has been rejected on account of scoring or improper shape—a common fault of steel dies.

While Germany concentrated on carbides, powder metallurgists in the United States turned to common metals such as copper, tin, zinc and lead. In 1922 a bearing manufacturing company started manufacturing pressed, self-lubricating bronze bearings and other parts for automobiles.

OILLESS BEARINGS

The porosity of these bearings was such that they could be impregnated with oil up to 35 per cent. of their volume, and they generally outlived the cars in which they were installed.

However, the porous bearings business really got its start with washing machines, which in 1924 were still creaking along on wooden bearings. Maytog washing machines have used over 70,000,000 oilless bearings since then, and all told there are over 1000 million bearings silently oiling themselves in the depths of washers, electric refrigerators and cars.

Gradually the new material was put to better uses. It was found ideal for porous filters to protect the oil-injector nozzles of Diesel engines, for example, and fine wire-mesh filter screens are also being pressed out at a great saving over the old method of weaving the wires.

FOR BRAKES, CLUTCHES

With modifications, pressed bronze makes a superb friction facing for heavy-duty brakes and clutches. In this process, flat, briguetted slabs of sintered bronze are bonded to steel plates, and every United States tank now being produced has this material in its clutch plates.

Pressed bronze facings are in the disc-

(Continued on Page 13)

PUZZLED? — THIS IS HOW IT WORKS:

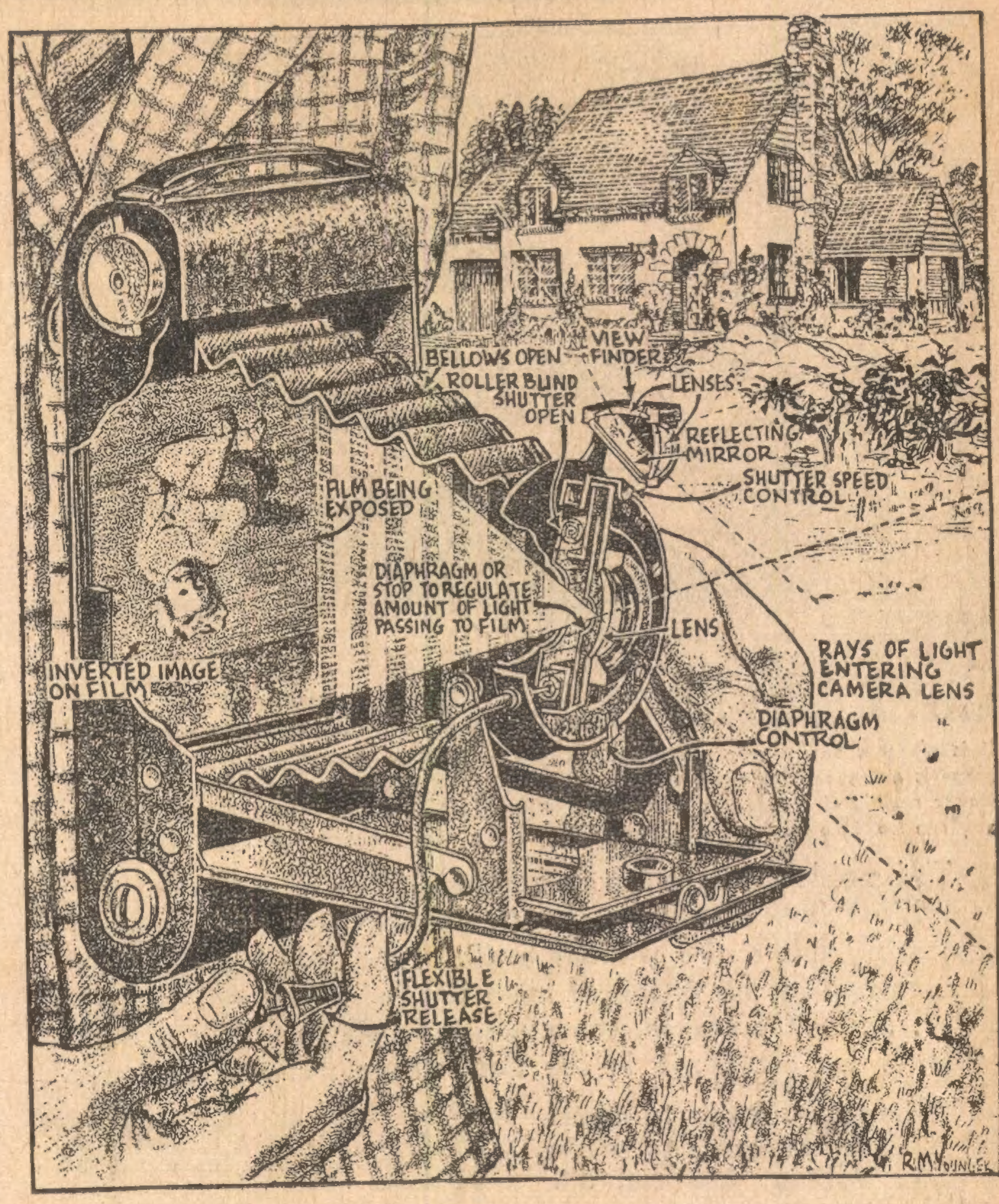
THE CAMERA

So familiar have we become with the photograph that we seldom stop to think what a wonder this is, or how rapid have been the developments in photography from the early crude daguerreotypes of a century ago.

THE cameras of today are amazingly compact and efficient. The picture-diagram here shows just how the camera is able to capture the scene before it.

All objects reflect or throw back at least a portion of the light which falls upon them. White and the bright colors obviously reflect the most light, black and the dark colors the least. It is due to the power of the eye to distinguish the variations of this light that we are able to "see" and to distinguish brightness from darkness.

The lens of the camera is able to collect reflected rays of light from every part of the scene in front of it. The camera shown in the picture is actually in the process of taking the photograph, and the shutter is open, allowing the light rays, after being criss-crossed by the lens, to pass through to the back of the camera. Here an inverted image of the scene is thrown, for a fraction of a second, on to the sensitive film.



CHEMICAL CHANGES

The action of this light brings about changes in the nature of the wonderfully sensitive chemicals with which the film is coated. The most important of these chemicals belongs to the class known as silver salts—compounds of the metal silver with certain other chemicals. The silver salt most often used is silver bromide, and this is fixed to the film (or in the case of some cameras, the plate) by a gelatine coating. The sensitised films must be kept screened from light. This is done by wrapping the film in a quantity of opaque paper.

During the brief moment that the "roller blind" shutter with its circular opening has allowed the light through to the film the silver salt has seized every detail of the image and put it on record, though without, as yet, any visible effect.

If we think of the silver salt on the film as a chemical compound in which the silver holds its companion, the bromine, a prisoner, we can imagine that when the rays of light strike the film they loosen the hold of the silver upon the bromine, and where the brightest rays strike this the hold is loosened most.

But the bromine cannot escape without the assistance of another chemical, called the developer. When the film has been completely "exposed," it is taken to the photographer's darkroom, opened up and placed in the developer bath.

Now all the bromine that can possibly get away passes over to its new friend, leaving the silver stuck in the gelatine coating. According to the lights and shadows of the scene, varying quantities of the bromine escape. In the lightest parts nearly all the bromine goes, on others less, and so on down to the darkest parts of the image, where scarcely any is released.

"FIXING" SOLUTION

This leaves a good deal of the original silver salt on the film, still sensitive to any light, which would set it free and spoil everything. So the plate must next be put in another chemical bath, the fixing solution, composed of "hypo" (sodium hyposulphite), which dissolves all the remaining silver salts.

Thus the finished negative, no longer sensitive to light, is produced. All the details in it are now composed of pure metallic silver embedded in the gelatine —the greatest amount of silver being in the places that received the brightest light.

The negative can be "printed" on to sensitive paper by allowing light to pass through the negative. The picture thus recorded is reversed from what was on the film, the lights now becoming dark and the darks light. It is thus a true replica of the original scene.

In the construction of the camera it is worth noting that the picture can be focused by a lightproof bellows arrangement which enables the lens to be moved closer to or further from the back of the camera.

A view finder, composed of two lenses and a slanting reflecting mirror, shows the photographer what his picture will be like. The device which enables the shutter to be operated for a moment to "snap" the picture is worked by the pressure of the thumb.

* * *

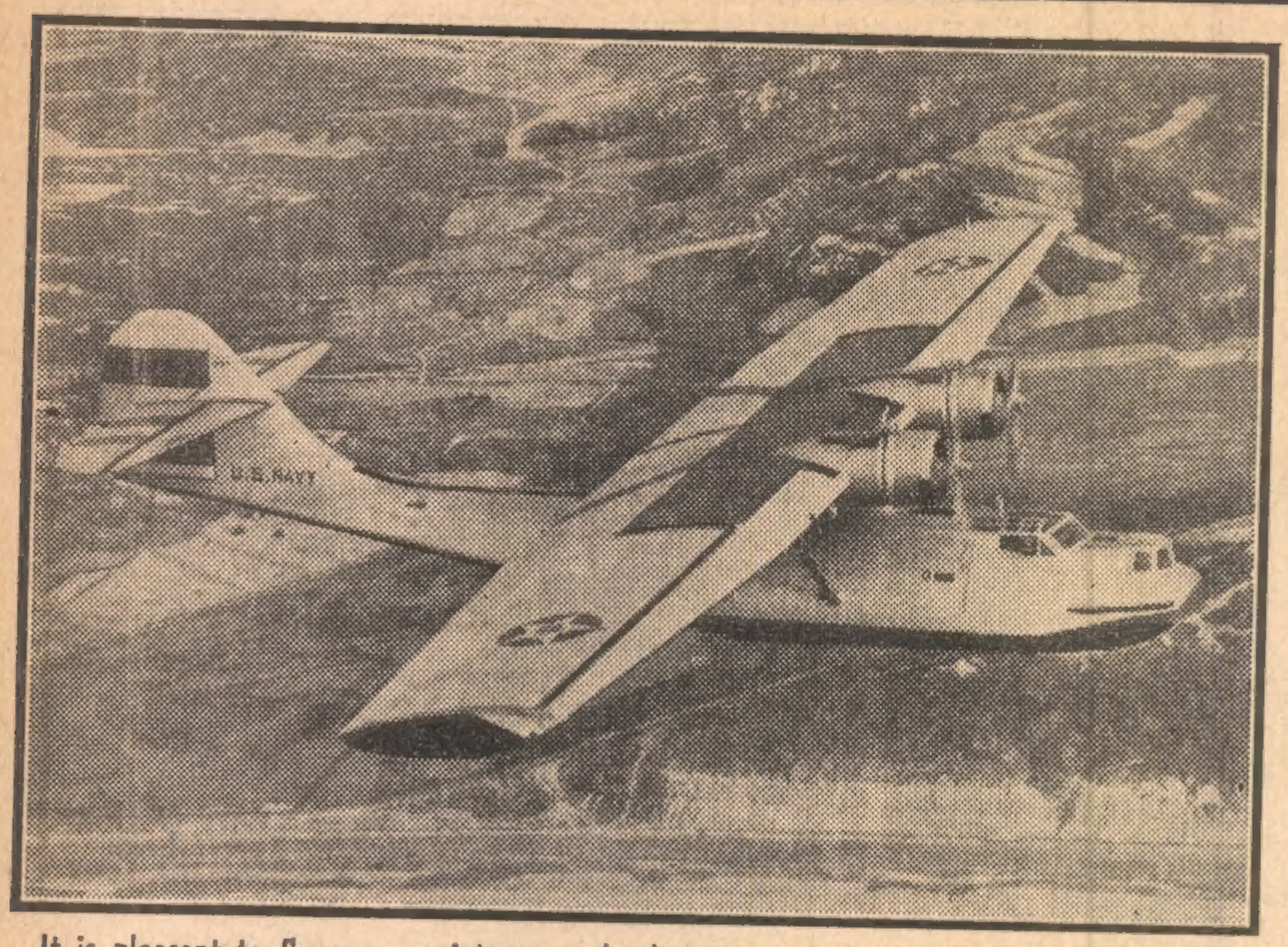
U.S. Planes For 1943

AS far as numbers are concerned, United States plane output for 1943 will be nearly double the output in 1942, when 49,000 planes were built.

American bombers will be bigger and heavier than in the past. They will carry more guns, and will be equipped to carry heavier bomb-loads.

Thus, total weight of American combat aircraft in 1943 will be four times the weight of aircraft built in 1942.

CAMERAS PENETRATE DARKNESS AND FOG



It is pleasant to fly over a picturesque landscape on a clear day—but not when the plane is on reconnaissance and when the landscape is heavily guarded enemy territory. Under certain circumstances infra-red photography is a valuable asset, in that it allows a plane to take pictures through mist and fog which obscure it from the ground.

To be able to see in the dark has been one of man's dearest ambitions for centuries past. As yet, he has not been able to satisfy this desire without artificial aid, which is perhaps just as well for his peace of mind for "what the eye doesn't see . . . " Of course, some wiseacre will probably remark that, if we could see in the dark, there wouldn't be any.

I AM, however, ready to admit that if we were able to see in the dark without artificial aid it would be very handy.

The imaginative mind can think up many occasions when this would be of use. I can remember the times when I have forgotten to put out the milk jug, and I have had to crawl out of bed in the dark in a dazed condition, only to make violent contact with the edge of the door in my efforts to find the light switch.

Then, of course, there are the times when the torch has gone bung in the blackout, and one has had to strike a few matches, or switch on the light, which provides vocal practice for the local warden.

A BOON TO BURGLARS

What a boon it would be to the burglaring trade to be able to see in the dark. But, of course, this would be conditional on the capacity being confined to that profession, otherwise it would become more of a hazard than a virtue.

Mankind for years has always struggled to progress beyond his capacities to use the things he invents, in a manner that would be of real benefit to him.

No one can deny that the lot of man has been generally eased by the wonderful inventions that have been given to the world. But think of all the wonderful inventions that have not been given to the world, because they would menace the profits of some vested interests.

We nearly missed out on the wonderful sulphanilamide drugs because a German firm tried to cash in on it and get a monopoly.

Possibly something of the kind would happen if someone invented a method of seeing in the dark, for there are quite a number of present-day aids that would be made obsolete at once, and this would never do. would it?

by Calvin Walters

However, to get back to our subject. There is one invention that approaches the idea of seeing in the dark, but you have to have a camera to make it effective. I refer to the method of photography that makes use of the infra-red rays.

In order to get some idea of what I am going to talk about, it wouldn't be a bad idea if we made a short study of the science of light.

Light is an electro-magnetic phenomenon. By this is meant that light consists of waves in space similar to the waves that are used in broadcasting. These waves have a definite length, and it all depends on the length of these waves whether the optic nerves connected to our eyes translate them into colored light or white light—or no light at all.

The wavelength of the electromagnetic waves also determines whether our senses feel them as heat, or whether we must use other apparatus and use them, as wireless waves, X-rays, &c.

WHAT COLOR IS WHITE?

White light is not simply white, just another color. "Hold on," you say, "that is a contradictory statement." But it is not. White light is a blending of many colors, which, all mixed together, produce the color sensation which we refer to as white.

To prove this, we use a prism of glass and direct on to it through a narrow slit, a beam of white light.

The prism of glass will deflect the light from its straight and narrow path and split it up into its component colors, which will be seen as a band, like a rainbow, on the screen on to which we direct the beam.

This band of colors consists of seven main colors, namely, violet, indigo, blue, green, yellow, orange, and red.

A rainbow is merely white light, split up again by shining through the raindrops.

This range of colors is called a spectrum.

The reason that the prism of glass splits up the white light is as follows:—Each color is distinctive, because it is an electro-magnetic wave, with a different order of wavelength to any other color.

As the light shines through the glass it is bent or, as we say, refracted. The longer the wavelength the less the ray is bent. All the colors appear as such in the spectrum, because red, being of a longer wavelength than orange, will not be bent as much as the orange. Orange is longer than yellow, and so on down to violet, which is the one bent the most. A glance at the sketch will make this clear.

ANGSTROM UNIT

The wavelengths of these rays have been measured. Don't ask me how. They are so short that no tape measure will do for measurement. The unit used is the Angstrom unit, which is the ten-millionth part of a millimetre.

It is the smallest physical unit, so small that it is hard to imagine it. But we can see evidence of it—as a color.

The wavelength of violet light is 3900 Angstrom units, while that of red light is 7700 Angstrom units.

We have spoken so far of colors appertaining to light. But there are the colors that are not self illuminating, such as the petals of a flower, of cloth, and paper.

The most beautiful color on earth seems to be green. I might be excused for mentioning a pound note. At least, it seems to me that the prime object

WONDERS OF INFRA-RED PHOTOGRAPHY

of many people's lives is the accumulation of money.

I believe that a sort of browny-red is another good color. A ten pound note is of this hue, so I am told. I haven't seen one for a long while, so I will have to depend on hearsay.

These colors I speak of are red, or green, or yellow, because the substance of the material absorbs all the waves of the other colors and reflects the red or green or yellow wave. Intermediate colors are combinations of reflected wavelengths of different colors.

White is white, because all the wavelengths of the spectrum are reflected. Black is black because all the wavelengths are absorbed.

If a thermometer is passed through the spectrum from the violet end, a continuous rise in temperature is recorded as the thermometer approaches the red end.

INFRA-RED RAYS

Beyond the red the temperature rises still further, indicating that there are other rays, invisible to the eye, beyond the red.

Because these rays lie beyond the red end of the spectrum, they are called infra-red. It is well to remember that, although the rays are called infra-red, they are not a color. The term infra-red merely indicates that they lie beyond the red end of the spectrum.

The ray next beyond the violet end are called ultra-violet, because they have a higher wavelength than the violet, the word ultra meaning above or beyond.

In order to distinguish between heat rays, which affect us by their sensation of warmth, and infra-red rays, the definition of infra-red rays has been fixed as follows:—

Infra-red is that part of the spectrum adjoining the extremity of the visible red, and covering the wavelengths from 7700 Angstrom units to 3,000,000 Angstrom units.

In 1873 H. W. Vogel was experimenting with his photographic materials, with a view to preventing the scattering of light in the sensitised surface of his plates.

He added certain dyes to the emulsions, and noticed that the plates then became sensitive to radiations outside the normal region.

PHOTOGRAPHIC DYES

This led Vogel to experiment still further, with the result that he discovered that certain dyes sensitised the emulsions to green rays.

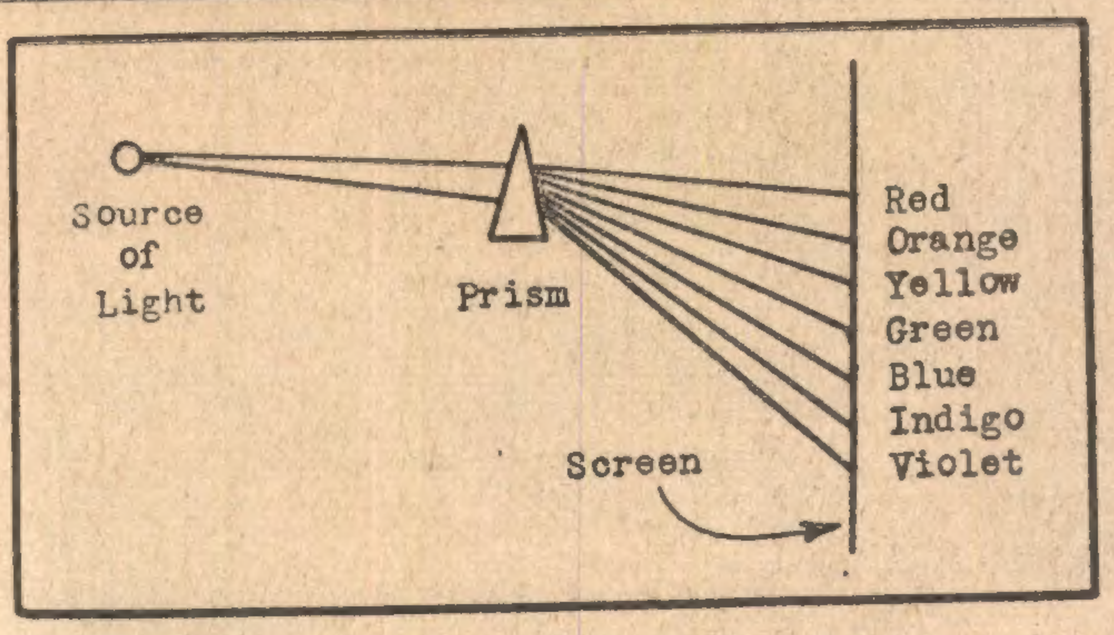
Further, the extra sensitivity always occurred around the region of the absorption band of the sensitising dye.

A very large number of dyes have since been experimented with until, finally, emulsions were made that would be sensitive to infra red rays of about from 8000 Angstrom units to 11,000 units.

One of the most sensitive dyes is Xeno-cyanine, and this is now extensively used to sensitise photographic plates for infra-red photography.

Certain precautions have to be taken when using plates that are highly sensitive to infra-red rays.

For instance, Xeno-cyanine plates must be kept under refrigeration, as the dye is unstable at room temperatures.



By means of a prism a beam of ordinary white light may be broken up into its constituent colors. Rainbows are formed by the action of raindrops or particles of water in the air which break up the sun's rays into the various colors of the spectrum.

The cameras, too, have to be inspected as regards their ability to prevent infra-red rays from entering, except through the lens.

Materials used in the camera are usually wood, metal, leather, and felt. Certain woods are partly transparent to infra-red rays. Mahogany, for instance, is an offender in this respect. Yellow deal is freely transparent, while ebony is opaque.

Leather is transparent, and the bellows for this reason must be efficiently blackened on the inside.

In the dark room itself, special dark room lamps must be used. A blue-green light is generally used for this purpose.

INFRA-RED PHOTOS

Now that infra-red photography has been brought to such a high stage of development, the applications of the principle have increased.

One of the chief uses is the photography of objects through fog, haze, and mist.

The reason that we are able to do this is that the longer the wavelength of a given light the greater its powers of penetration of water vapor in the atmosphere.

Thus, the further we go up the spectrum, the further the light will penetrate.

Yellow rays travel further than blue rays. Hence the yellow filters that motorists place in front of their headlamps in misty weather.

Infra red rays have much greater power of penetration than any rays in the visible spectrum. Therefore, when we take a photograph on a material that is sensitive to infra-red, we can "see" much further on the photo. than we can with our eyes, which are not sensitive to infra red.

Of course, we cannot see through heavy clouds, but thick mist is not opaque to infra-red rays.

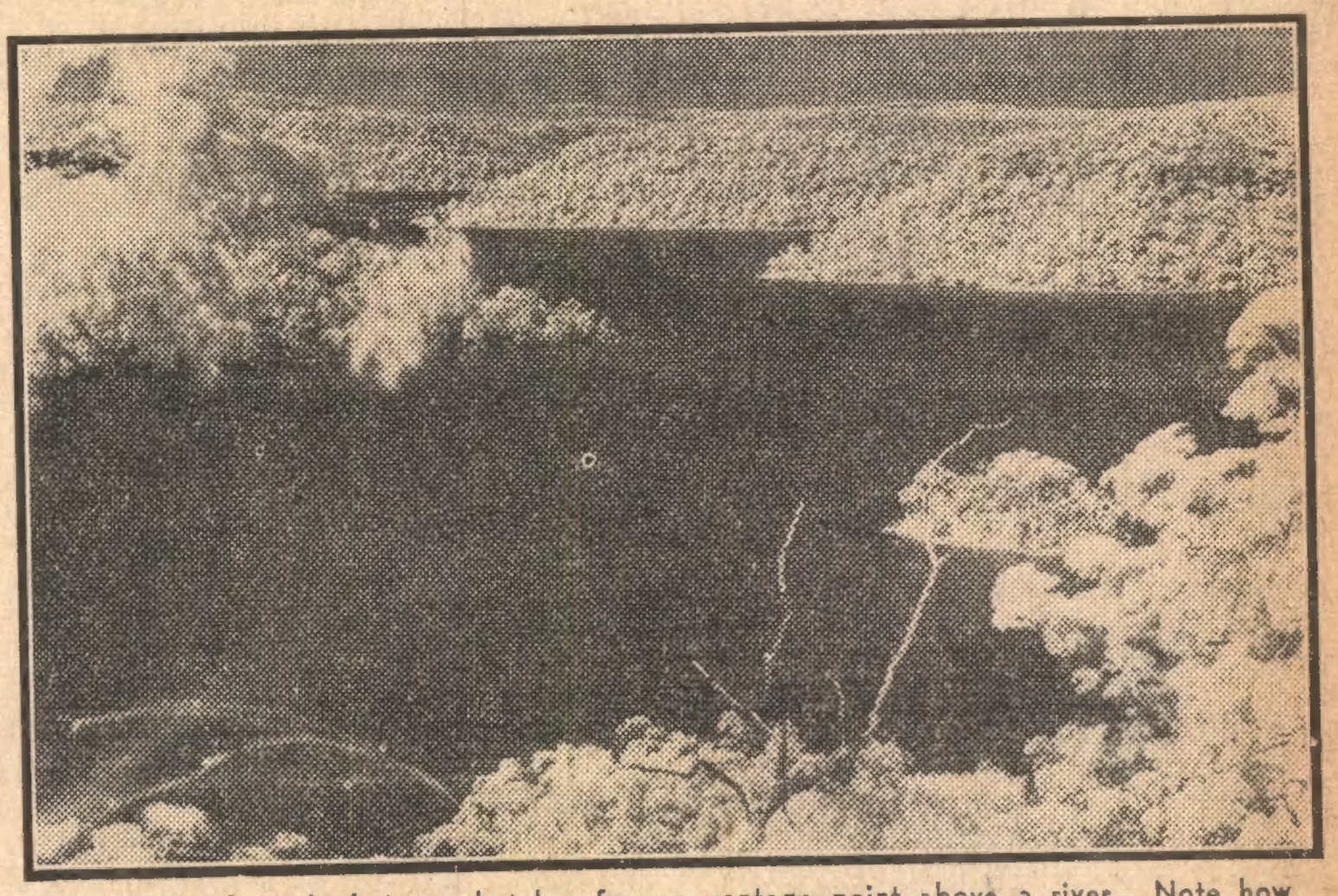
FOR RECONNAISSANCE

It can thus be seen how important infra-red technique is in warfare, for, by means of aerial photography, it is possible to fly over enemy territory and take surveys of the land in weather that normally would be too misty for ordinary photography. The plane is also more free from enemy interference under such conditions.

Another important use for infra-red is the testing of fabrics.

Many fabrics may look alike, but the different composition may have different degrees of capacity to reflect infra-

(Continued on Next Page)



A typical infra-red photograph taken from a vantage point above a river. Note how the distant horizon stands out clear against the sky. To the natural eye the two would merge and be lost in haze. Note how the water registers as almost black and devoid of reflections.

POPULAR SCIENCE

INFRA-RED PHOTOGRAPHY DEFIES HAZE

From a purely artistic point of view infra-red photography makes possible some beautiful and rather startling effects. The above picture was taken on an infra-red plate. In the original print, mountain peaks are clearly visible although situated up to 60 miles from the camera.

red rays. It is thus possible, by taking infra-red photos of the fabrics to detect adulterations in the material. The method is also used to detect adulteration and impurities in drugs and dyestuffs.

In regard to fabrics, it is generally believed that black is a "hot" color, because it absorbs infra-red rays. But this may not always be so. Some blacks are "hotter" than others.

It is thus seen that, if for some reason black must be worn, infra-red photography could be useful, for by taking photos of different black materials, it would be possible to choose that material which appears lighter than another in the photograph; this would be "COOLER" than one that came out black.

In criminology, infra-red photography is extending its usefulness in the detection of forged documents and erasures and superscriptions.

A special infra-red lamp is used to illuminate the document, and a photo taken on an infra-red plate. If the ink used by the forger has the same color, but is a different composition to that used in the original signature, it is possible that the two inks may have different degrees of infra-red absorption, and will thus show different degrees of intensity on the plate.

EXPOSES ERASURES

Also, it has its uses with documents where erasures may be suspected. Owing to the varying degrees of absorption of infra-red rays, it is possible to find out what was originally written in the text.

The contents of a letter may sometimes be read without opening the letter, by taking a photo. by infra-red rays, when the contents become visible on the photographic plate.

It is possible to take photographs in the darkness by floodlighting the scene with lights in front of which has been placed a filter that prevents all but the infra-red rays from penetrating.

The scene will thus be floodlit with infra-red rays, and the floodlights will not be seen, as there is no visible light coming through the filters.

By concealing a camera in such circumstances, even a self-operating camera, a photo can be taken without the knowledge of anyone. The implications are obvious.

Another useful application of infra-red photography is that in the field of medicine. It is fortunate in this regard that infra-red rays have the power to penetrate the epidermis or outer layer of skin.

By "illuminating" the surface of the body with infra-red light, and taking a photo on a suitable plate, the network of veins under the skin can be easily photographed, thus showing any abnormality or obstruction, and rendering great aid to diagnosis and subsequent treatment.

For skin complaints the method has no value, but further development in subcutaneous photography must be expected.

It has been also possible to photograph the iris of an eye, in which the cornea has become opaque with cataract, and the retina of the eye has also been photographed, opening up great possibilities in the diagnosis of eye complaints.

Infra red has its uses in astronomy. Many new facts have been discovered about distant stars in this way. Certain features that do not come out on ordinary plates are quite clear on infra-red plates.

A photo of the spectrum is called a spectogram. Spectograms of the planet Saturn, taken on an infra-red plate, led to the discovery that the spectrum of the ring around Saturn extended further into the infra red than the spectrum of Saturn itself. But, in the short wave region, the spectrum is weaker.

This strengthened the belief that the ring was composed of cosmic dust, i.e., very fine particles of dust from other heavenly bodies.

It has been further shown by infra-red photography that the atmosphere of Saturn and Jupiter contain large quantities of ammonia and methane, which is considered to have some bearing on the distribution of the elements through space.

The latest application of the use of infra-red rays, apart from photography, is in the drying of paint on sheet metal in motor car manufacture.

DRYING PAINT

Ordinary electric light bulbs, as is well known, generate a large amount of heat. Engineers have been able to increase the heat output of the bulb and reduce the light output, so that about 10 per cent. light is given off, and the rest is radiant energy of heat.

These lamps are called infra-red lamps, and emit infra-red rays, as distinct from ordinary heat rays, so that the human body can feel little warmth coming from the lamp.

However, by arranging the lamp in a suitable reflector (gold being found to be the greatest reflector of radiant energy, the reflectors are thus gold-plated), and concentrating the beams of infra-red rays on to the wet painted surface, drying of the paint is accomplished in double quick time.

The reflectors must be properly designed, as they have a bearing on the area covered by the rays, the intensity, and the rate of absorption.

Banks of lamps are used, and are mounted on portable trolley arrangements, which can be run around as desired.

Infra red rays penetrate the paint, and drying proceeds uniformly throughout the product. No surface film is formed, as in ordinary drying.

No ovens are necessary, as the rays are focused directly on to the work by the reflectors, and there is consequently no wastage of energy.

Reflectors other than gold-plated ones have been developed, such as aluminium, which are proving effective.

SPEEDS UP WORK

Within three or four minutes' application of the rays, lacquer primer surfacer undercoats can be sanded. On synthetic enamel, it is possible to rub polish and sand within 15 to 20 minutes.

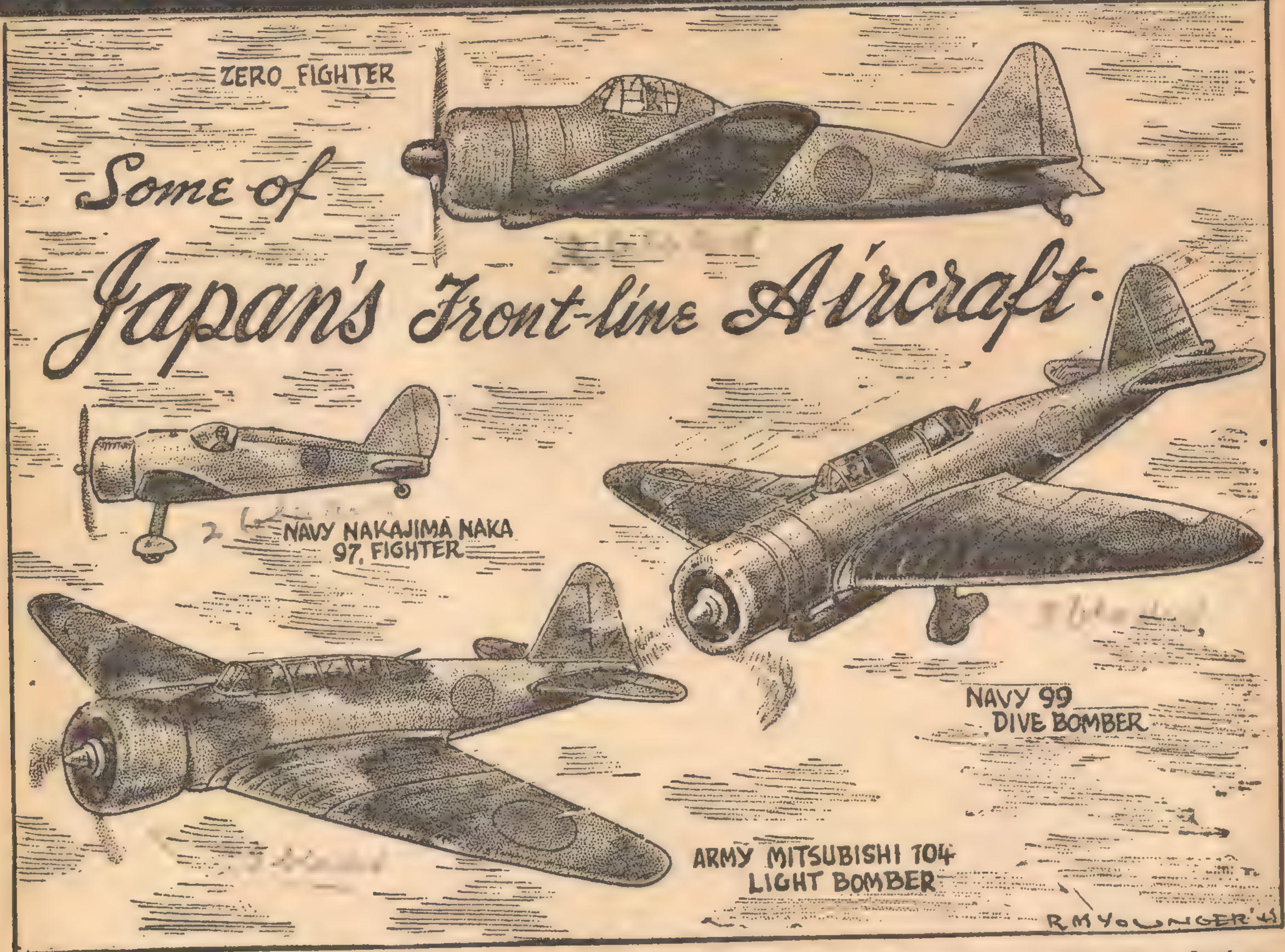
The lamps are placed at a distance of 3ft. from the work. They work at a very low temperature, which, of course, assures a very long life, normally about 4000 hours.

As the radiant energy begins to operate immediately the current is switched on, it is easily seen that a considerable saving in electric power is achieved by the elimination of preheating, required for the oven baking method.

These lamps are also used for the following purposes:—Warming greases in transmission, when changing the grease, thus enabling more of the old stuff to be removed. Drying wet ignition wires. Drying wet upholstery. Drying out carburettors. Expanding metal for fitting purposes.

It is not hard to imagine that homes will soon be equipped with such lamps for the purpose of drying clothes on a wet washing day, drying the floors instead of the labor of mopping. Drying dad's shoes after walking home from work in the wet (he will have to do it himself). There are even possibilities of getting a thirst up in the winter time.

THESE PLANES ARE MAKING HISTORY



Before the Pacific war began, nearly everybody, some experts included, under-estimated the quality of Japanese aircraft. A rude awakening came in the early months after Pearl Harbor; but today, when the Allies have the measure of the Japanese and are sending first-class machines to oppose them, the story is changing.

AMERICAN authorities have emphasised that Allied aircraft losses are now much smaller than those of the Japanese.

Sketched above are some of the widely-used Japanese types. The single-seat Zero (at top of sketch) is an "open book" to the Allies, since the capture in the Aleutians of an undamaged specimen.

When experts had their first glimpse of the plane, they drew their breath in amazement, for, they found, it was built with amazing attention to fine detail. Its extreme lightness, due to the absence of armor, self-sealing petrol tanks, and other protective equipment, was apparent.

In terms of flying, this lightness means that the Zero is extremely manoeuvrable, fast, and with quick climb. Stream-lining is carried almost as far as it can go—there is not a rivet protruding to mar the even flow of air over the wings and fuselage, which are finished with a remarkably smooth film of tough rust-resisting lacquer.

Structurally, the Zero is interesting because the fuselage and wings are fashioned in one piece, giving great strength. The captured Zero was a late model, with folding wing tips to enable handling by ground crews.

The Zero is built for offence, and cannot stand up to the fire-power of Allied fighters. It must depend on its speed and "nimbleness" to keep out of the way.

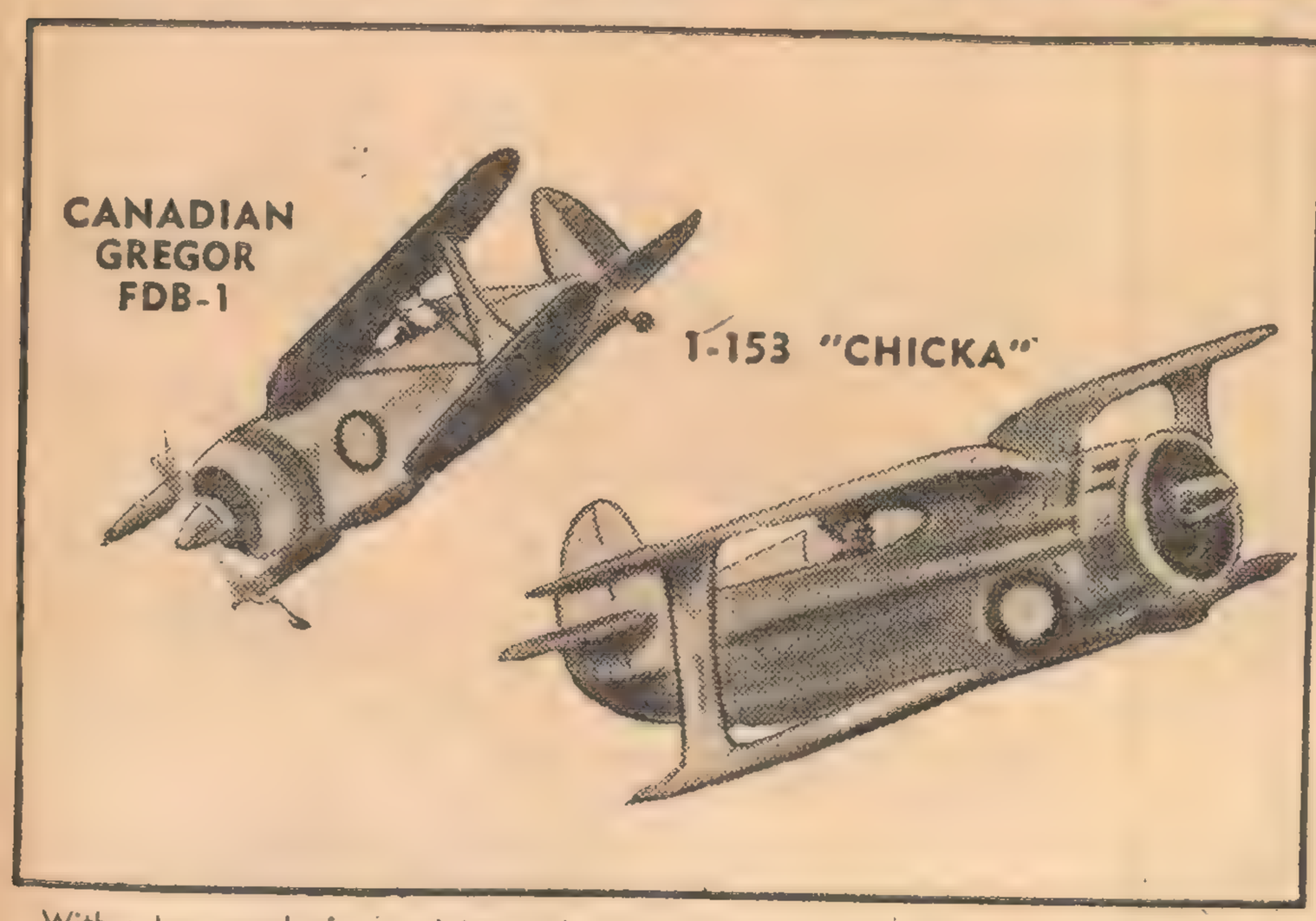
The Zero's armament consists of two 7.7 mm. machine-guns in the nose for tracer bullets, and two 22 MM. cannon in the wings. The 900 hp engine is similar to the air-cooled American Pratt and Whitney. In a moderate dive, the plane reached 380 mph, but normal top speed is well below that. A new Zero has square wing tips. The type used from carriers has a fixed undercarriage.

The Army "104" bomber, constructed by the Mitsubishi Company, and sketched lower left, is a light two-seat type. The fuselage is faired down from the cockpit to a large, fairly sharp fin. Protective armament consists of fixed guns in the forward fuselage, and moveable guns for the rear-gunner. The plane's span is of 47 feet. It is less than 30 feet in length. Speed, with newer engines of 1000 horsepower or so, is probably about 300 mph.

The navy's type 99 divebomber (right) is a low-winged machine with fixed undercarriage. Wing tips are rounded. Forward firing guns and a rear-gunner's position are for defence. The plane bears some points of general resemblance to the British naval divebomber, the Blackburn "Skua." Speed of the Japanese plane is about 250 mph, the dimensions being much the same as those of the Mitsubishi 104.

The older Nakajima Naka 97 (upper left) has a fixed undercarriage, being for use from aircraft carriers. With the less powerful engines of a three years or so ago, the plane was said to have a speed of about 220 mph, but latest types of the Nakajima fighter, probably modified, are reported to be fitted with a 1050 horsepower engine, and to have a speed of 350 mph.

GERMANY'S VAST PROBLEM IN THE EAST



With a top speed of around 300 mph and possessing a high degree of manoeuvrability the I-153 Chicka fighter conforms to a pattern now regarded as obsolescent. The drawing serves to illustrate the similarity of the Chicka to the earlier Canadian Gregor fighter-bomber FDB-1.

In the December, 1942 issue, we published an article dealing with some of the earlier types of Russian operational aircraft. In this issue, we deal with certain of the more modern types which the Russians are putting into the air, in support of their present terrific offensive on land.

by John French

INFORMATION and photographs of Russian aircraft are extremely hard to obtain because of a fairly strict Russian censorship. As a result the information available comes largely from Germany, who has every reason to be interested in the development of the air force of the USSR.

At the outbreak of war, the Soviet Air force consisted, for the most part, of outdated and outgunned aircraft. However, this state of affairs exists no longer and the air fleet of the USSR is now meting out to the Luftwaffe in the east almost as big a thrashing as it received at the hands of the RAF during the Battle for Britain.

ARMY CO-OPERATION

It would appear from the facts available that the Russians have concentrated on close support types of machlines for co-operation with the Army, and rather neglected the heavy bomber, though now heavy four-engined bombers are actually in service.

Obviously, it was necessary for the Russians to develop their army co-operating machines first, since it had in Germany an enemy whose air force had worked in close co-operation with the army and swept across Europe taking all before it.

At the outbreak of hostilities, the Russian Air Force was desperately short of aircraft capable of co-operating with the Army, but today there is a different tale to tell. Russian twin-engined light bombers, reconnaissance bombers, medium bombers, and single-engined dive-bombers are of high quality and equal to similar planes in service anywhere in the world.

The first official news of modern aircraft in Russia came through Lord Beaverbrook, after his return from the Soviet in September, 1941. "The Russians," he said, "have most skilfully developed two new types of aircraft. One is the M1G-3 Fighter, which corresponds in design and performance to our Hurricanes and Spitfires. Just as these planes are superior to the German fighters in the west, so have the Messerschmitts in the east met their match in the M1G-3. The other is the Stormóvik dive-bomber. This aeroplane has proved an outstanding success in attacks on troop concentrations and the breaking-up of enemy formations."

Since then the Stormovik has been in the news constantly, and appears to be the main Soviet dive-bomber and ground strafer. Designated the 1L-2 (B.Sch.), the Stormovik is a low wing, single-seat, single-motored monoplane with backward retracting undercarriage. This protrudes from the wing in a faring, similar to that used in early Seversky and Republic Fighter designs, and the wheels are only half retracted.

Power is supplied by a 1300 hp AM38 in-line liquid-cooled Vee motor. Reports have it that it was developed from the Heinkel He 118, but it is also similar in appearance to the Fairey Battle.

Armament consists of two 32mm cannons and two machine-guns in the leading edge of the wings. Around the motor and cockpit are special armor plates for protection in low level attacks.

FINE ATTACK PLANE

This machine has been a great success already in attacks on tanks, troop concentrations, enemy positions, and so on. Actual sizes are not known, although from pictures and silhouettes it seems to come into the 50ft.-60ft. wingspan class, with a length of 40ft.-45ft. and a height of about 12ft.

Two bombs are carried externally outward from the undercarriage. Some Stormoviks are known as rocket bombers, being specially fitted to take bombs fitted with a rocket in the tail, giving extra propulsion. Penetration and a flat trajectory in a low-level attack is the object of the scheme.

Speed of the Stormovik with full operational gear is about 300 mph, which is quite a creditable performance for a single-engined machine of this size.

The other machine mentioned by Lord Beaverbrook, the M1G-3 fighter, is perhaps the latest Soviet fighter in active service. It has probably been improved upon since.

It is a low-wing monoplane with the wing slightly swept down from the root to the undercarriage pivot point, then up again. The cockpit is well back and nearer to the tail unit than is general with fighters. This gives the machine a very long nose, in which is housed a 1200 hp AM-35A liquid-cooled Vee in-line motor. Top speed of the earliest version is 360 mph.

MIG-3 AS FIGHTER-BOMBER

Reports, mainly from German sources, give the armament as one heavy and two light machine-guns. This was later brought up to four heavy guns, and it has probably been increased still further since cannons became an important part of fighter armament.

Most of the squadrons in service are fitted with external racks on the wings capable of taking two 250lb. bombs. Thus, like most of Russia's older fighters—the Rata 1-16B, 2KB-20, Chato 1-15—and our own Hurribombers, this machine can be used very effectively for ground strafing and as a low-level bomber. It was known earlier as the 1-18 and also as the 1-61 and 1-200.

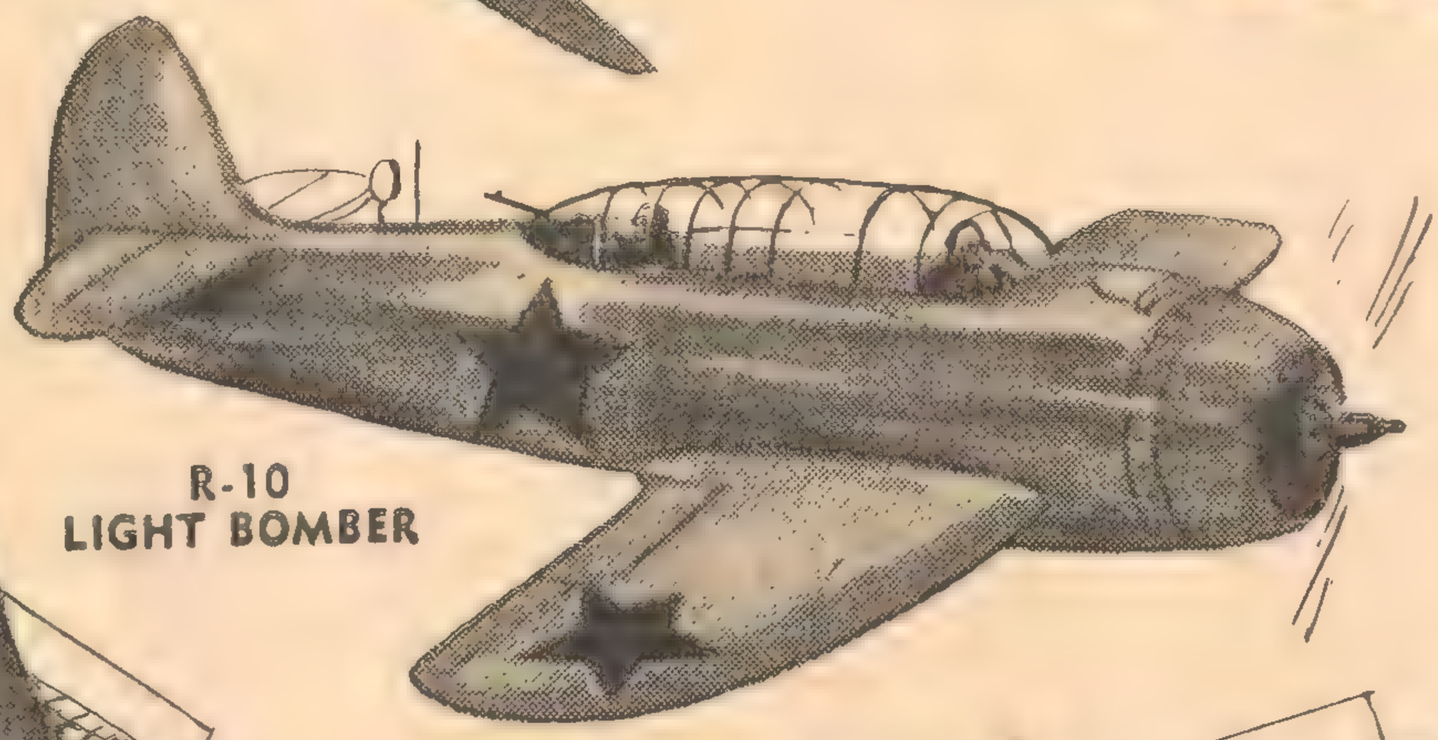
Another Russian single-seat low-wing fighter, about which little has been said, is the 1-26. This machine is somewhat similar to the Hurricane, and more like our fighters in appearance than the M1G-3. **(Continued on Page 12)**

RUSSIA HAS MANY MODERN AIRCRAFT

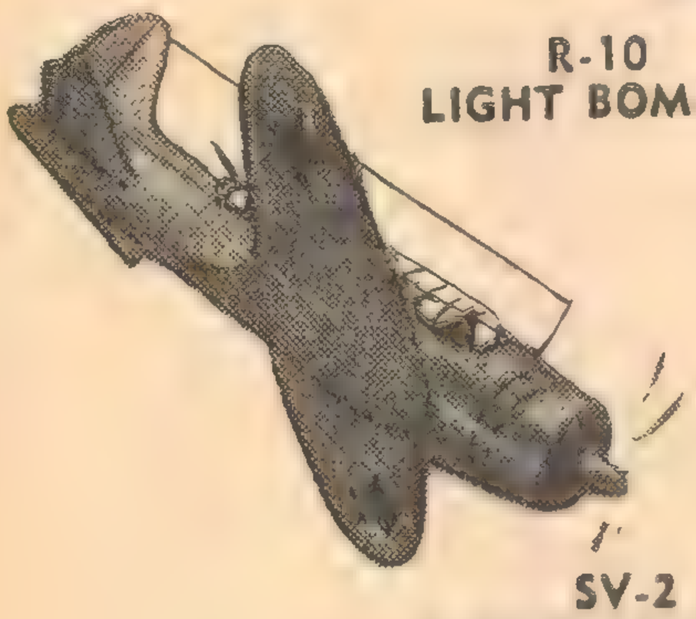
R-8
SINGLE SEAT
ATTACK BOMBER

IL-2
"STORMOVIK"
DIVE BOMBER

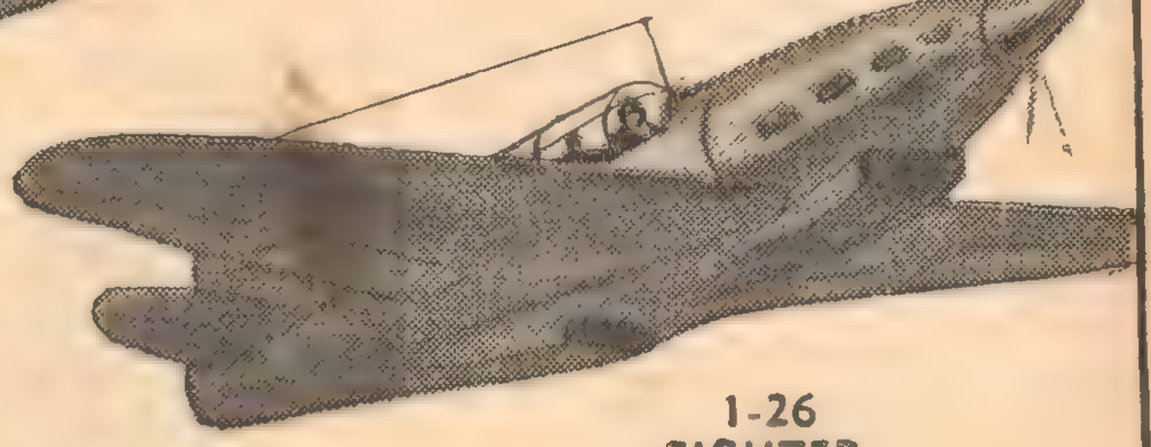
RUSSIAN AIRCRAFT



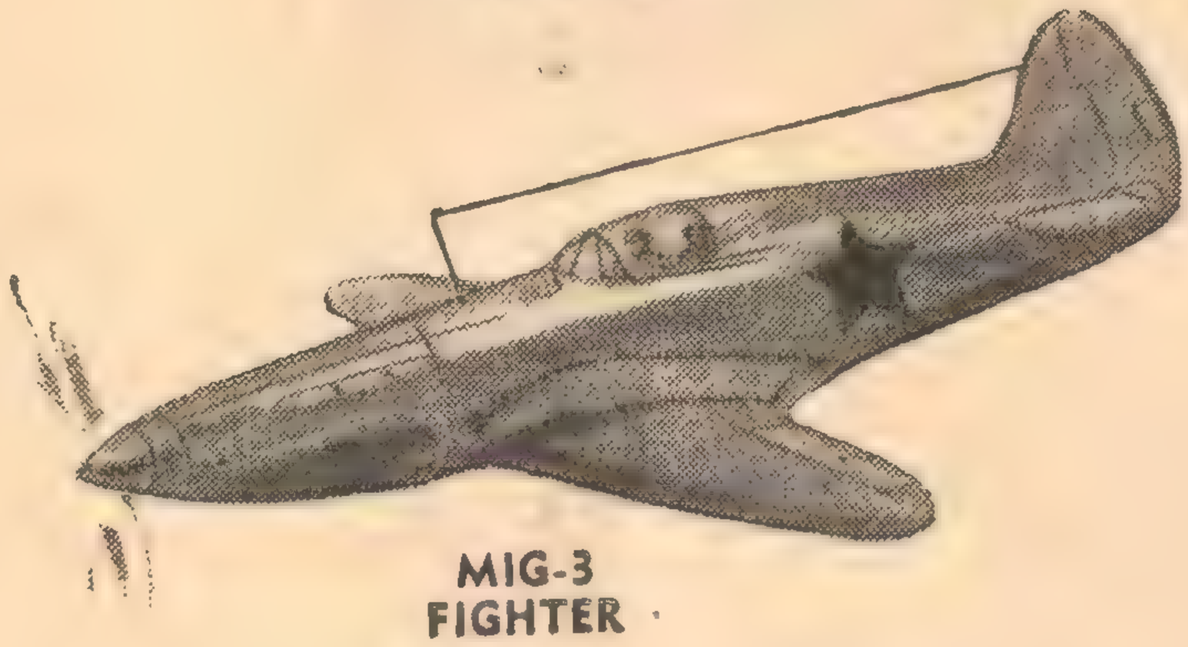
R-10
LIGHT BOMBER



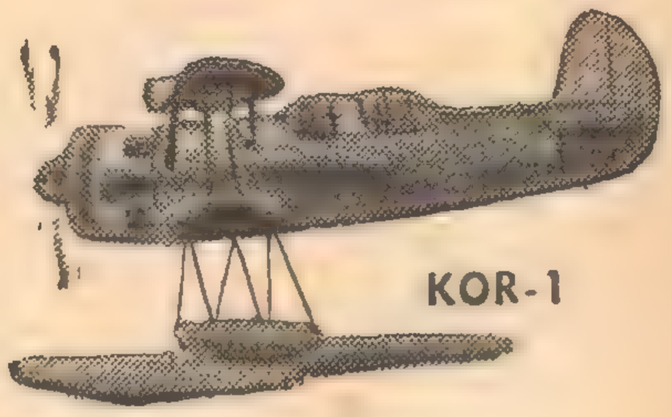
SV-2
LIGHT BOMBER-
FIGHTER



1-26
FIGHTER



MIG-3
FIGHTER



KOR-1

RUSSIAN GLIDER PILOTS IN TRAINING

Before the war gliding was a popular sport in Russia. Nowadays trained glider pilots are valuable indeed. The Russian Ossoavikhim—somewhat similar to our air training corps—has over 20,000,000 members and is prolific source from which can be drawn large numbers of semi-trained airmen.

It is powered with a 1100-hp M-105 liquid-cooled Vee motor and armed with a cannon and two machine-guns. It has a speed of about 300 mph. Actual sizes are not known, but the span would probably be about 40ft. and the length about 32ft. However, these figures may be wide of the mark. The 1-26, like the M1G-3, has a fully retracting undercarriage which retracts inwards.

A new fighter which has been in action is the 1-153 Chicka. It is very like the Canadian Gregor Fighter-Bomber FDB-1 in appearance.

Details released in November of 1939 reveal that the Canadian machine is powered with a 750hp Pratt and Whitney Wasp Junior; had a maximum speed of 300 mph; an absolute ceiling of 32,800ft.; a wing span of 28ft.; overall length of 21ft. 8in.; overall height of 9ft. —in., and a gross weight of 4250lb. However, it was never sent into service production.

MORE POWERFUL MOTOR

The Russian machine, being a more recent development of the Gregor idea, is powered with a 1200 hp Wright Cyclone and is slightly larger. The machine is a biplane fighter and the upper wing is gulled into the fuselage.

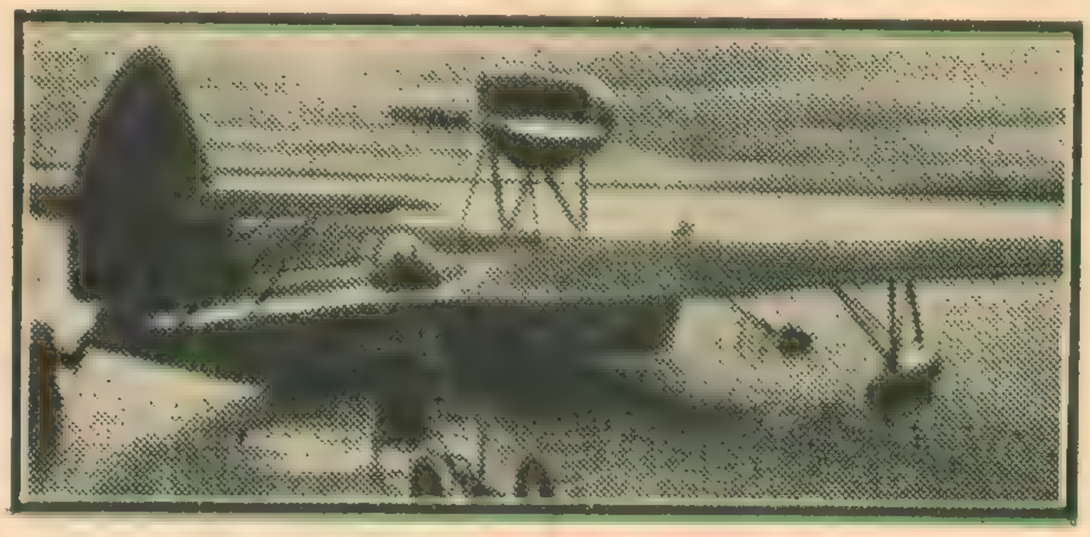
Armament consists of four heavy machine-guns mounted to fire through the propeller, and the machine can carry two 250lb. bombs beneath the wings for low bombing work. The undercarriage retracts fully into the fuselage. The speed is reported to be over 250 mph with full load, but its manoeuvrability makes up for lack of speed.

Another Russian aircraft which is fairly new from the production line is the R-8 single-seat attack bomber. This plane has not yet been listed as having seen action. It is extremely like the US Navy's latest machine—the Vought-Sikorsky XF4U-1 fighter. A large machine with inverted gull wings, the R-8 carries a bomb load of 1200lb. and has four machine-guns set in the wings outside the propeller arc. Speed is around the 250 mph mark. Details of size and weight are not available.

Nor have Russian designers limited themselves to single-engined single-seat aircraft. Several new two-seat single-engined monoplanes are mentioned, and at least one of these has seen action.

The R-10 is a single-engined, low wing monoplane, which is used mainly for light bombing, fighting and reconnaissance work. It has a 1000 hp M63 radial engine, giving a speed of over 275 mph with full load. It is a very clean-looking design, following the modern trend of the two-seater.

Equipment includes extensive radio apparatus, and the machine is armed with four heavy machine-guns, two in each wing outside the propeller arc, and one heavy machine-gun in the rear cockpit. The undercarriage is of the single leg variety and fully retractable.



The Russian MBR-2 flying boat employed by the Russian Black Sea fleet. It is powered with an 850 hp motor, has a top speed of about 155 mph and is armed with two machine-guns.

The other two-seat machine of note, which has seen a good deal of service, is the SU-2 light fighter bomber. Sometimes referred to as the BB-1, the machine has a rear gun turret on similar lines to the Brewster Bermuda. Power is supplied by a 1000 hp M-88 air-cooled radial.

The bomber version is armed with two heavy forward guns in the wings, of about .5 calibre, and one movable gun in the turret. The fighter version, also in service, is reported to be equipped with four forward machine-guns. The bomb load exceeds 1000lb. Speed of the bomber with full load is around the 280 mph mark, while the fighter's speed is about 300 mph. As in all cases, these figures are not official.

Under the Lend-Lease arrangement, Russia has also been receiving modern American machines such as Airacobras. This machine in particular has been mentioned in fighting on the Russian front. A complete wing of the RAF fighter command has also been in action in Russia, and, during its period of service until the end of 1941, they had been accounting for 15 of the enemy for every one lost to themselves. In this instance, earlier models of the Hawker Hurricane were used.

TRANSPORT AND SEAPLANES

Both Russia and Germany realise the advantage of mobility and of supplying and reinforcing front line troops quickly. Such machines as the ANT-6 and TB-3 are now being used for paratroop work and the quick transport of urgently required supplies.

Another single-engined aircraft which has seen service in the Black Sea is the MBR-2, a high wing monoplane with deep hull and high set tailplane with single fin.

The tailplane is strutted, and the single motor is of the pusher variety, mounted high above the wing. It is powered with an M34 liquid cooled Vee motor of 850 hp. Top speed of this aircraft is only 155 mph, and it is used for spotting and patrol work in conjunction with the Black Sea Fleet.

The KOR-1 catapult seaplane is also serving with the Soviet Navy. This machine is a two-seat biplane version of the 1-16 Rafa monoplane. It has a large central float, and two wing tip floats mounted below the fuselage. It is used, as its name suggests, for catapulting from ships of the Soviet Navy.

The engine is a Cyclone of 1000 hp. Its engine is closely cowled with small cooling inlets in front, and armament consists of two fixed guns firing forward through the propeller and a movable gun in the rear cockpit.

AMBULANCE AIRCRAFT

Many other machines are being used, including the Stal-3, an old biplane with N bracings and uncowled radial motor of less than 600 hp. This is being used for ambulance work.

These old machines, about the equivalent of our Westland Wapati, are fitted to carry a pilot and two patients, and are constantly moving back and forth from front-line battle areas to bases behind the lines. The R3 and R5 and other old reconnaissance biplanes are now being used for the same work, or for training.

The Soviet has a large number of gliders. No doubt these are some of the troop-carrying gliders with which Germany, America, and Britain are experimenting. They are extremely useful for training purposes, and probably a large percentage of Soviet pilots have learnt to fly with them.

In addition to the planes mentioned, Russia has also a range of medium and heavy bombers of modern design.

RADIO LINKS U.S. AND THE ANZAC AREA

Day after day, the great American broadcasting networks bring to their listeners up-to-the-minute news of the war, relayed direct from the fighting fronts. Australia enters the news spotlight, together with London, Honululu, Ankara and other focal points throughout the world. Behind these news broadcasts is a story of technical achievement, reflecting credit on the radio engineers of the Allied nations.

Directly George Folster hears "Go Ahead" in his phones, he flicks the switch which opens the microphone into the Columbia-Maine NBC Network.

Sydney has become the radio despatch centre for American correspondents who daily keep their compatriots abreast of war in the Anzac area.

Their broadcasts, taking their place in the regular schedule of 130 minutes each week and heard by something like 40,000,000 American listeners, represent a lot of free publicity for Australia. Estimated at current advertising rates, the figure for time only would run into thousands of pounds.

From a studio under that tall lattice-work AWA tower, which rises far above Sydney, morning and night word goes to American listeners. Our engineers have achieved smooth co-operation with the US networks through split-second timing.

A week ahead cables convey allocations to correspondents, timed to even a second. As example:—

"Dunn to CBS September 27, 130125-130344." This acceptance time by San Francisco, being sent in GMT, was converted to our daylight saving time, thus: "Dunn to CBS, September 28, 000125-000344."

Deciphered, it meant that Bill Dunn, correspondent in Australia for Columbia Broadcasting System, went to the short wave microphone in Sydney for a newscast to San Francisco at one minute 25 seconds after midnight on Sunday, September 27; and went off the air at three minutes 44 seconds on Monday, the 28th September.

Besides Bill Dunn, there is George Folster for National Broadcasting System (which, by the way, has nothing to do with the US Government, all American communications being privately owned and operated) and Stanley Quinn for Mutual Broadcasting System.

Since American radio was born on November 2, 1920, when Pittsburg (Pennsylvania) opened KDKA, development has been so rapid that 693 commercial and 39 experimental stations have opened. Those with the prefix W are in the Eastern States; those with K in the Western States.

HUNDREDS OF STATIONS

When AWA links in all its Australian confederates, 25 stations are synchonised—which is a pretty good partial coverage for 1,300,000 sets. But the four big US networks (The Blue is the other) tie up 421 out of the 693 stations which feed America's 14 million sets. Mutual links up 116 stations, Columbia 120 stations, and NBC 100 stations.

It speaks volumes for our private enterprise that Australian radio has been so developed that, when war suddenly demanded regular trans-Pacific oral circuits, they were available. This co-operation the US networks appreciate. It is another manner in which the two nations combine to smash the Axis.

THE STORY OF POWDERED METALLURGY

(Continued from Page 4)

type brakes on the wheels of some 35 per cent. of all American fighting planes, including practically all bombers.

As another development, National Cash Register is trying to adapt the principle of the self-oiling porous bearing to the making of self-inking porous metal keys for typewriters.

The idea is to impregnate the key permanently with ink, and thus eliminate the use of ribbons. Chrysler cars now use a self-oiling iron door striker plate, which is not only cheaper and stronger than its die-cast equivalent, but, with the lubricant impregnated, it ends the nuisance of passengers collecting oil spots on their clothes.

NEW ALLOYS

Aside from these developments, there is another basic aspect of powder metallurgy that would make it of great importance even without the commercial possibilities of the high-speed stamping process—that is the nature of the alloys that can be produced.

In forming an alloy by usual methods the component metals tend to lose their individual characteristics entirely, and the alloy is a new metal with new characteristics of its own. But with powder metallurgy any combination of metals may be pressed into a pseudo-alloy, if this is desired, and each metal will retain its several properties.

The most impressive illustration of the value of powdered-metal alloy occurs in materials for welding electrodes, contact points, circuit-breakers, &c. For example, the old-fashioned silver—or copper—alloy electrical contact quickly fused and pitted when making or breaking heavy current.

Today such contacts may be pressed from powders of copper and tungsten, with the former contributing its high conductivity, the latter its high resistance to heat.

The question of powder metallurgy is still largely in the research stage—eight of ten of America's leading factories are even now contributing jointly to the upkeep of a laboratory devoted solely to powdered metallurgical research. There are many fundamental questions still to be answered. It is not yet clearly understood just what occurs during the sintering process.

One explanation of the phenomenon is that when the metal is powdered the surface area of the particles is vastly increased. When a cubic centimetre of metal is ground into powder particles that will pass a 300-mesh screen, its surface area may be increased from six to the vicinity of 10,000 square centimetres.

Over this whole area there is a play of free surface energy, which is roughly comparable to "surface tension" in liquids. Under pressure and heat there is an interlocking of the atoms within the mass.

Cost of metal powders is today an important obstacle to the development of powdered metallurgy as a serious rival of melting and casting throughout industry.

A second limitation concerns the dimensions and shapes of articles that can be pressed. It is impossible to press many types of curved or bent pieces, because these cannot be extracted from the dies, and on account of the fact that the powders do not flow evenly under pressure, irregularly shaped pieces of varying thickness are now almost impossible to make.

LIMIT TO DIMENSIONS

It is also impossible at present to press pieces of any great dimensions. This difficulty will be overcome in part with the introduction of heavier presses, but here again the cost problem intrudes.

The heavier the press, the greater the original investment, and the greater the cost of providing power for total pressures that may be as high as 10,000 tons on presses now contemplated. The ultimate solution to this may lie in the perfection of the "hot press" process, whereby the powders are simultaneously pressed and sintered under pressures only one-tenth as high as those required today.

Despite these disadvantages, there is no doubt that powder metallurgy will make increasingly greater strides, and become an important factor in the industry of the future.

ITEMS OF NEWS FROM A WORLD AT WAR

Heinkel Four-motor Bomber

INCREASED attention has been drawn to the Heinkel He 177 since reference was made recently to this German machine by Wing-Commander Aitken in a BBC talk. Some particulars of this big bomber were published in American papers early in 1940, and details of its construction and performance reached Britain also. In over-all dimensions the Heinkel He 177 approaches the Short Stirling and the Avro Lancaster. The span is 103 feet 4 inches, and its length is 67 feet 3 inches, and it is 18 feet 2 inches in height. The four 1460 horse-power Mercedes-Benz DB603 engines are arranged in pairs in two nacelles in the wings. Its loaded weight is stated to be 71,600lb., and it is supposed to have a maximum speed of 280 miles an hour. Rumors stated that this new enemy bomber has a great range, but so far no details have become available to confirm the claim that it can cover 7040 miles at a cruising speed of 180 miles an hour.

* * *

4403 Ships In 12 Months

THE US Maritime Commission expects 4403 ships, of all types, to be completed for the year ending June 30, 1943. This was stated by the commission's chairman, Admiral Land, before the House of Representatives Appropriations Committee. By the end of the year there would be 1,000,000 shipbuilding employees. The figure in 1939 was 55,000.

New Super Transport

LOCKHEED'S new super-transport plane, the Constellation, made its maiden flight recently in California, USA. The plane was originally designed as a luxury stratosphere airliner to carry 60 passengers non-stop across the US continent in under nine hours. In its new role as a transport, the plane can carry as many troops with full equipment. Alternatively, carrying a tank, it could fly almost non-stop to Australia. Speed is not stated, but it is claimed that the plane is faster than some fighter planes still in service.

* * *

New Surgical Instruments

ARMY SURGEONS in the Middle East are using new types of surgical instruments which "floodlight" the interior of the body.

Made of a transparent plastic material, which transmits light round corners, does not conduct heat, and is virtually unbreakable, the instruments are made in about 30 different shapes, to suit any kind of operation.

Similar instruments have been made in other countries for some years past, but they had the disadvantage of losing their shape in sterilising. The new instruments, however, are made of a methyl-methacrylate plastic specially developed by British chemists, which will stand any amount of boiling without losing shape.

REPUBLIC P.47 NOW IN SERVICE

New wonder plane, the P.47 "Thunderbolt," fastest, highest climbing and longest radius fighter in the world, is now at the service of the Allies.

During trials in America it dived at well over 700 miles an hour and is reported to have been officially clocked at more than 400 mph in level flight.

The P.47, which weighs about 6½ tons, is the creation of Alexander Kartvell, a Russian, who is chief engineer of the Republican Aviation Corporation of America.

Heavily armored, it is yet capable of operating at 35,000ft. It is driven by a 2000hp Pratt and Whitney radial engine. Its gun power is comparable to the impact of a five-ton lorry hitting a brick wall at 60mph.

According to a recent announcement, the production of Grumman Wildcats and Avenger naval planes will be increased to more than four times the 1942 figures.

Beauforts Built In Record Time

IN no other country in the world have torpedo-bombers and bombers been been produced in so short a time as in Australia, the Director of the Beaufort Division of the Department of Air Production (Mr. John Storey) said recently.

Discussing the development of the industry, which began just two years ago, Mr. Storey said the Beaufort had already proved itself not only as a reconnaissance plane, but as a torpedo and ordinary bomber.

"The secret of the Beaufort is its versatility. It has a range of 2500 miles, and can reach any point in Australia within 24 hours."

Mr. Storey said the number of people now engaged in the industry totalled 10,000, of whom 3000 were women.

Speaking on the subject of Australian-made aero engines, Senator Cameron said the site on which the factory was built was nothing but a waste two years ago. Today, complete aircraft engines were in large-scale production. Practically the whole of the materials used in their manufacture were produced in Australia.

AUSTRALIA'S NEWEST STREAMLINED LOCO.

Built for the New South Wales Government Railways, this new streamlined locomotive has just undergone its preliminary trials. Designated as type 38, it is the most powerful express engine in Australia. Overall length is 78ft 6in, weight approximately 190 tons and service speed 75mph.

* * *

New Quick-freezing Process

ARGENTINA'S meat packers are busy on a new quick-freezing process which will result in a big saving in ship cargo space. The scheme involves the removal of bones from meat, compression and quick-freezing. A ton of quarters prepared in this way occupies 50 cu. ft. of cargo space, compared with 106 cu. ft. per ton for chilled meat, and 80 cu. ft. for frozen boned meat.

Noiseless Movie-Camera

FOR the first time since sound motion pictures came into use, more than ten years ago, the motion-picture industry has a noiseless camera which can be used inside a sound studio without any sound-proofing box, or "blimp," as it is known in the industry.

The new silent camera, weighing 60lb., has been described before the Society of Motion Picture Engineers by G. Lambe, of the Twentieth Century-Fox Film Corporation. The monitor view-finder truly conforms to the image being photographed on the film so that the camera-man no longer has to make allowances for parallax. The camera turret mounts four lenses which are quickly changed, while the entire camera is sealed from the action of sand, dirt, or water.

* * *

Paint Made From Slate

CAMOUFLAGE paint is now being made from the millions of tons of waste from slate quarries of Cornwall and Wales. In making the tiles or slates, time is more costly than the raw material. If a piece of slate rock does not split easily into the shape required it is thrown aside. Ground into a coarse powder, slate goes to the making of camouflage paint. In finer form it is a useful filler in paint used as an undercoat for metallic surfaces. It also appears as a cheap distemper and in roofing felt to take the place of tiles for war factories.

* * *

"Cold-proof" Clothing

AN Arctic explorer, Surgeon-Commander E. W. Bingham, is the designer of new cold-proof clothes for seamen.

His new garment is being tested on a large scale in convoys to Russia.

A two-piece windproof outer garment, with smock, hood, and trousers, is worn over an under-garment of duffle.

It is tied with strings at waist and ankles, and supplemented by special boots and woollen socks.

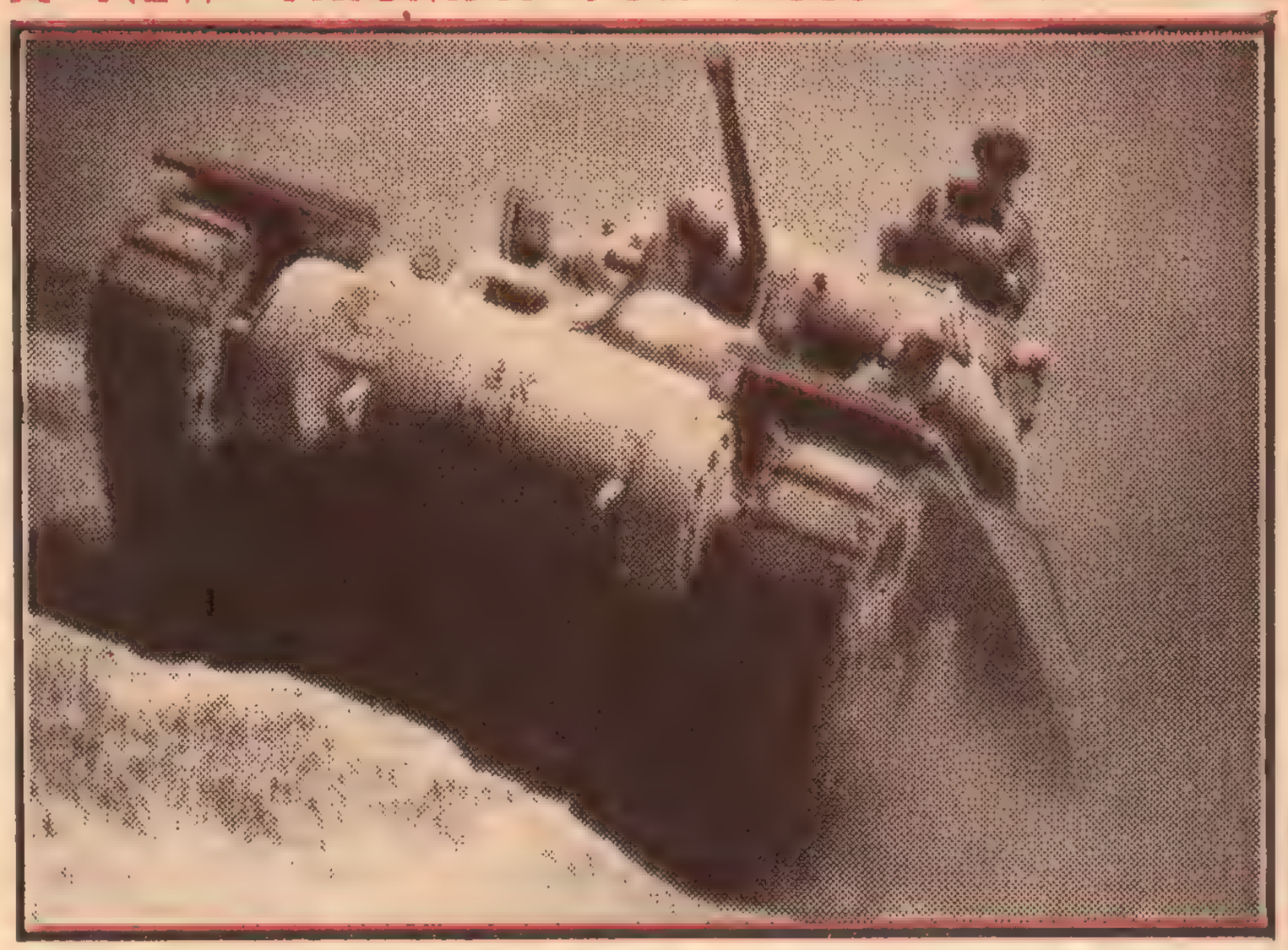
"It's no blooming fashion plate, but it looks mighty good to me," said a merchant seaman when shown the new garment.

* * *

New Torpedo Bomber

THE Fleet Air Arm will soon possess a new type of torpedo bomber to replace the slow, outdated Swordfish, says the "Daily Mail" naval correspondent. The new machine is a monoplane equipped to carry a torpedo.

A NEW TRIUMPH FOR AUSSIE ENGINEERS



Under duress of war, Australian industry has undergone tremendous expansion. Planes, ships and fighting vehicles are being manufactured at a rate that would have been unthinkable at the outbreak of hostilities. Our picture shows an All-Australian cruiser tank as it rumbles across the proving ground just after leaving the assembly lines somewhere in NSW. Australian engineers have led the world in the technique of casting tank hulls in one piece.

5000 Die Of Malaria

FIVE THOUSAND of the 40,000 population of Uribia (Colombia) have succumbed to a severe outbreak of malaria.

This is reported by Colonel Johnson, US Naval Attache, who flew doctors and medical supplies into the distressed area.

* * *

Italy Goes Dry

ACCORDING to a report from London, all alcohol in Italy is being commandeered for the manufacture of synthetic rubber and fuel. This has resulted in a complete prohibition on the sale of spirits.

Details of Messerschmitt 210

SOME details of the German Messerschmitt 210 aircraft have been announced.

It is a twin-engined, low-wing monoplane, with a crew of two.

It is designed for use as a long-range fighter, or dive-bomber, or for ground attacks.

It has a top speed of 370 to 380 miles an hour at 18,000 feet, 30 to 40 miles an hour faster than the Messerschmitt 110 twin-engined fighter, which is about the same size.

The Messerschmitt 210 is equipped with diving brakes. Six self-sealing fuel tanks are fitted in the wings, and have a capacity of 550 gallons.

Armament consists of two fixed 7.9 mm. machine-guns and two fixed Mauser 20mm. cannon in the nose. It has two 13mm. guns in a turret under the remote control of the wireless air-gunner.

A very large quantity of ammunition is carried.

The bomb bay is in the nose below the pilot's cockpit, and the bomb load is about 2200lb. There is about 910lb. of armor-plating on the new Messerschmitt 210, which has been compared to Britain's Mosquito bomber.

* * *

Armor-piercing Cannon

NOT only does Britain lead the world in aircraft development, but also in aircraft armament. The Hispano cannon-gun, now fitted to our fighters, fires a 9½oz. shell capable of penetrating more than a ¾-inch armor plating. Originally a French invention, the Hispano cannon-gun now being built in British factories has been improved as the result of operational experience by fighter planes and is now almost perfect. There are 220 parts to each gun.

FIRE-PROOFING CLOTHES

Flame-proof clothing, with which the British Air Ministry is experimenting, is expected to save lives and limbs of hundreds of airmen. Government experts are watching demonstrations of a secret process by which boots and overalls are treated with a solution that is reported to be proof even against petrol flames. These experiments were started by Sir Hector Macneal, 63-year-old shipowner, who decided to bear the cost of experimenting with fire-resistant clothing. Two Croydon scientists, father and son named Petzold, took up the search for a method of making all flying-kit flameproof. That was in October, 1940, and they have evolved what they call the Macneal process. Official tests have been applied to boots, ear-flaps and gloves, also to gabardine material and overalls. The fire-proofing solution has also been used on aircraft frames. An Australian, Mr. Arthur Mawson, of Five Dock, Sydney, also claims to have discovered a perfect fire-proofing preparation. He says it is also waterproof. An airman's uniform could be treated at a cost of 4s. The preparation is not injurious to the skin. He says it can be applied successfully to boots and overalls, and will resist even petrol flames, as claimed for the material the British Air Ministry is testing. However, one of the chief ingredients was manufactured only in America, and he had been unable to get permission to import more of it.

PRESENT VALVE REPLACEMENT PROBLEMS

A-C POWER PENTODES — BIAS CIRCUITS — THE EL3-NG

Although our local valve factories are working at full pressure, the greater part of their output is being absorbed for defence purposes. As a result, there are comparatively few valves available for civilian replacement purposes and servicemen and enthusiasts alike are continually coming up against the problem of replacing one particular valve type with another which happens to be available. In this article, the replacement problem is discussed in connection with a number of popular a-c power pentodes. Particular reference is made to bias circuits and to the EL3-NG.

ALTHOUGH literally dozens of different power valves have been used in Australian radio receivers, the actual quantities involved are quite small in many cases and mention of a few specific types will cover the majority of mains operated receivers.

Before passing to a discussion of individual valve types, it may be helpful to our less experienced readers to explain in some detail the methods of obtaining grid bias for output valves, since this matter must be understood before one type can be substituted intelligently for another.

The most commonly used is the cathode bias system, otherwise referred to as "self bias" or "automatic bias." A typical circuit is shown in Figure 1.

In most cases, the chassis of the receiver is common with the negative side of the high tension power supply. Thus, it is seen that the cathode of the valve returns to B-minus through a resistor, marked in the circuit as Rk. The grid of the valve returns directly to the chassis (i.e., to B-minus) through the grid return resistor Rg.

VOLTAGE AT CATHODE

Plate current, and also the screen current in the case of a pentode output valve, flows through the cathode resistor Rk and sets up a voltage drop across it. The direction of the current flow is such that the cathode assumes a potential positive with respect to the chassis. The order of this positive potential depends directly on the amount of current flowing in the circuit, and on the value of the resistor Rk.

Under normal conditions, no appreciable amount of current flows in the grid circuit of the valve. There is, therefore, no voltage drop across the grid resistor Rg, and the grid is necessarily at the same d-c potential as the chassis.

Thus, we have the cathode positive with respect to the chassis and also with respect to the grid. Having the cathode positive with respect to the grid is essentially the same as having the grid negative with respect to the cathode.

As far as the d-c grid bias is concerned, the function of the resistor Rg is merely to maintain the grid at the potential of the chassis. It is thus misleading to refer to it, as our readers sometimes do, as the bias resistor; a more correct name for it is the grid return resistor. In this circuit, the term bias resistor is more correctly applied to the cathode resistor Rk.

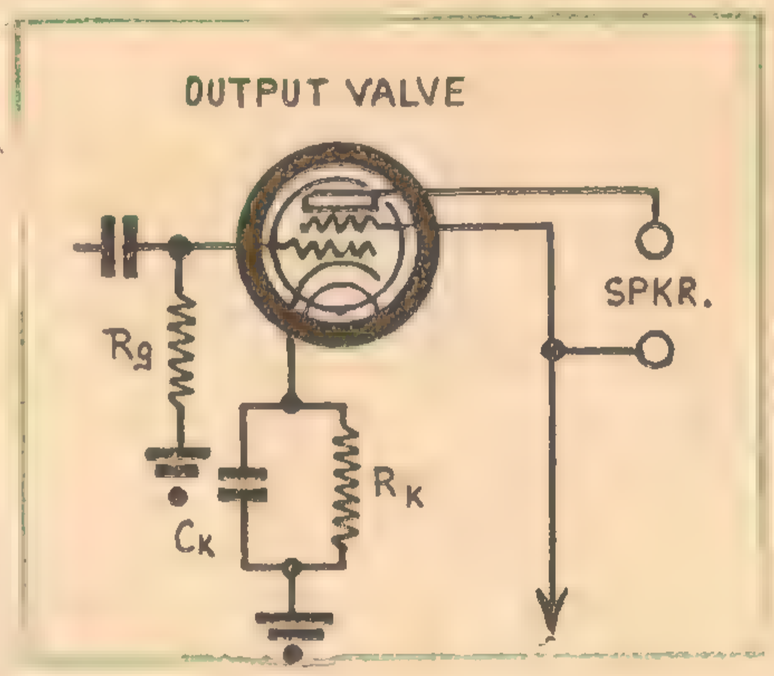


Figure 1. A typical circuit for an a-c power pentode, with self-bias. Rg is the grid return resistor, Rk the cathode bias resistor.

The value of the grid return resistor Rg is not extremely critical. For most a-c power valves, the upper limit is 0.5 megohm, a value selected by the valve manufacturers as being the largest which can be safely used without inviting trouble with grid current.

The lower limit is dictated by requirements of the previous amplifier stage. However, this is altogether another subject, which can scarcely be dealt with here. For most receivers and power valves, 0.5 megohm can be regarded as a good all-round value. In any case, when interchanging power valves, it is usually quite unnecessary to change the value of this grid return resistor.

THE CATHODE RESISTOR

The resistor which has to be carefully considered is the cathode bias resistor Rk, which, as we pointed out, really governs the amount of bias developed. The calculation of the correct value for any particular valve is a simple operation involving Ohm's Law.

When installing a new output valve, the first thing to do is to decide on the approximate conditions under which the valve in question will operate, and then, by reference to valve characteristic charts, to estimate the total cathode current which will flow through the bias resistor Rk. Knowing the cathode current and the required bias, it is then a simple matter to work out the value of the resistor required.

If the service data is not available and one is not in a position to work it all out theoretically, there would be some difficulty in arriving at the high tension voltage which might be available in an unfamiliar receiver after the new valve has been installed. Faced with three or four alternative sets of operating conditions for the particular valve, one would be at a loss to decide on which conditions to base the resistor calculations.

Fortunately, there are various circumstances which simplify matters considerably for the inexperienced enthusiast.

POINTS WHICH HELP

In the first place, it has been conventional for many years now to design ordinary a-c operated receivers so that the high tension voltage available for the valves is around the 250 volt mark. It may vary with individual receivers by as much as 20 volts either way, but, in the absence of more definite information, it is a pretty safe bet to calculate the cathode bias resistor on the basis of the ordinary 250-volt operating conditions.

Fortunately, the optimum value of the cathode bias resistor does not change radically with small changes in the applied voltages. The bias circuit is sufficiently self-balancing in most cases for a cathode bias resistor, calculated for, say, 250-volt operating conditions, to be perfectly satisfactory with applied voltages of between, say, 225 or 275 volts.

In any case, when the receiver is in operation with the new valve in place, it is not a difficult matter, if a voltmeter happens to be handy, to measure the operating voltages and see that they are near enough to the listed data.

When measuring the voltages on a stage with cathode bias, remember that the effective plate and screen voltage is that as measured between the CATHODE and the plate and screen. The grid bias voltage is equal to that measured between earth and cathode.

A final point worthy of note is that most of the pentode power valves used in a-c operated receivers during the last few years draw about 40 milliamps total from the power supply. Most notable exception is the 6V6-G, which nominally draws about 50 milliamps.

(Continued on Next Page)

by W. N. Williams

However, it has been quite common practice for receiver designers to overbias this valve somewhat, so that the current drain is much about the same as for other types.

Implication of this statement is that the replacement of any one of the ordinary pentode power valves with another type is not likely to upset the power supply to any great extent, provided, of course, the bias is changed to ensure that the new valve does actually draw its rated current.

TYPICAL CALCULATION

Now let us work out the bias resistor for a typical pentode output valve—say, the EL3-NG. Remember that the calculation is based on the total cathode current; this is equal to the plate current in the case of a triode, and to the sum of the plate and screen currents in the case of a pentode.

Assume that it has to replace, say, a 42 in an existing receiver. The complication of the different socket we will ignore for time being and confine remarks to the electrical side of the question.

Reference to a valve data chart shows that the plate current under the ordinary 250-volt conditions is 36 milliamps and the screen current 4.0 milliamps. This makes a total cathode current of 40 milliamps, which is almost identical to that of the 42.

The bias required is minus 6.0 volts for the particular operating conditions.

According to Ohm's law

$R = 1000 \times E \div I$,

where

R is the resistance in ohms,
E is the required voltage,
I is the current in milliamps.

Substituting the known values of voltage and current in the above formula, we have

$R = 1000 \times 6 \div 40.$

$= 150$ ohms.

It so happens that 150 ohms is quite a standard value of resistor. However, it frequently occurs that the calculated value is quite odd. A case in point is that for the 42 or 6F6-G, which works out at 410 ohms.

NON-STANDARD VALUES

In the event of the exact value not being available, it is usually better to err on the side of higher rather than of lower resistance. Thus, although a 400-ohm resistor would be satisfactory for the 6F6-G, one of 425 ohms would be preferable. Of course, the exact value can often be made up by connecting two resistors in series or in parallel, but the expense and complication is seldom warranted.

As far as dissipation is concerned, an ordinary 3-watt wire wound resistor will carry the cathode current of a single output valve well enough.

The cathode by-pass condenser Ck is usually included in the circuit to prevent degeneration and loss of gain. The capacitance is not critical, con-

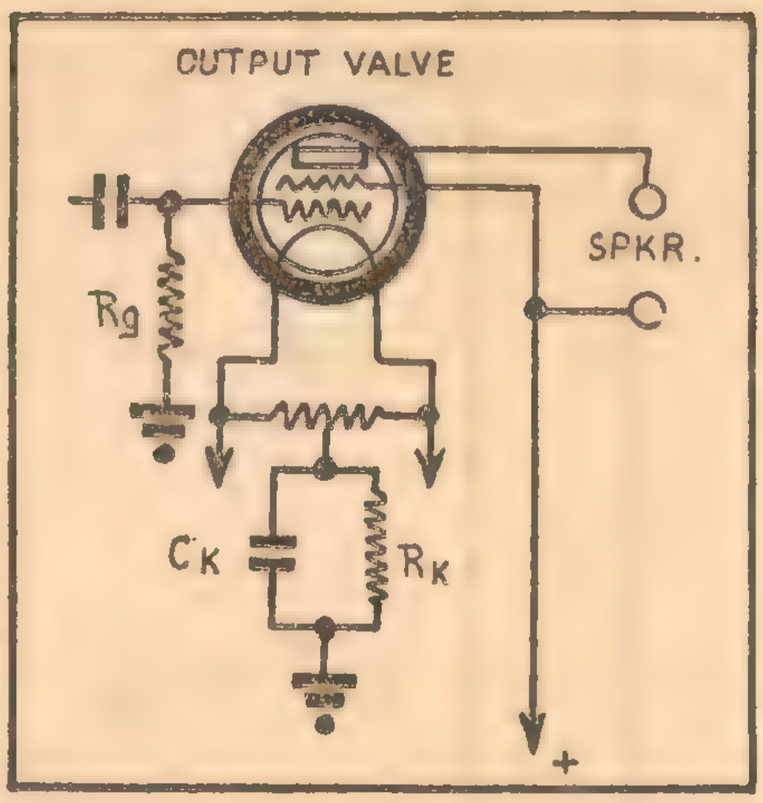


Figure 2. In the case of a directly heated output valve, the cathode bias resistor is connected between the chassis and the centre tap of the filament circuit.

densers varying in practice from 10 to 25 mfd. These are of the electrolytic variety and usually have a maximum rated working voltage of round about 25 volts and a peak voltage of 40. In practice, the 25 volt rating should not be exceeded, and, if it so happens, a particular valve requires more than 25 volts bias, it is as well to use two series-connected condensers across the bias resistor.

DIRECTLY HEATED VALVES

What might be considered a slight variation from the cathode bias system described is in the case of output valves with directly heated cathodes. Most common type is the 47.

In the 47, there is no insulated cathode sleeve, the emission being from the surface of the filament, as is usual practice with battery valves. The cathode bias resistor is therefore connected between the filament circuit and earth. In order to minimise hum, the connection is made either to a centre-tapped resistor shunted across the filament circuit or to the centre-tap of the actual heater winding on the power transformer.

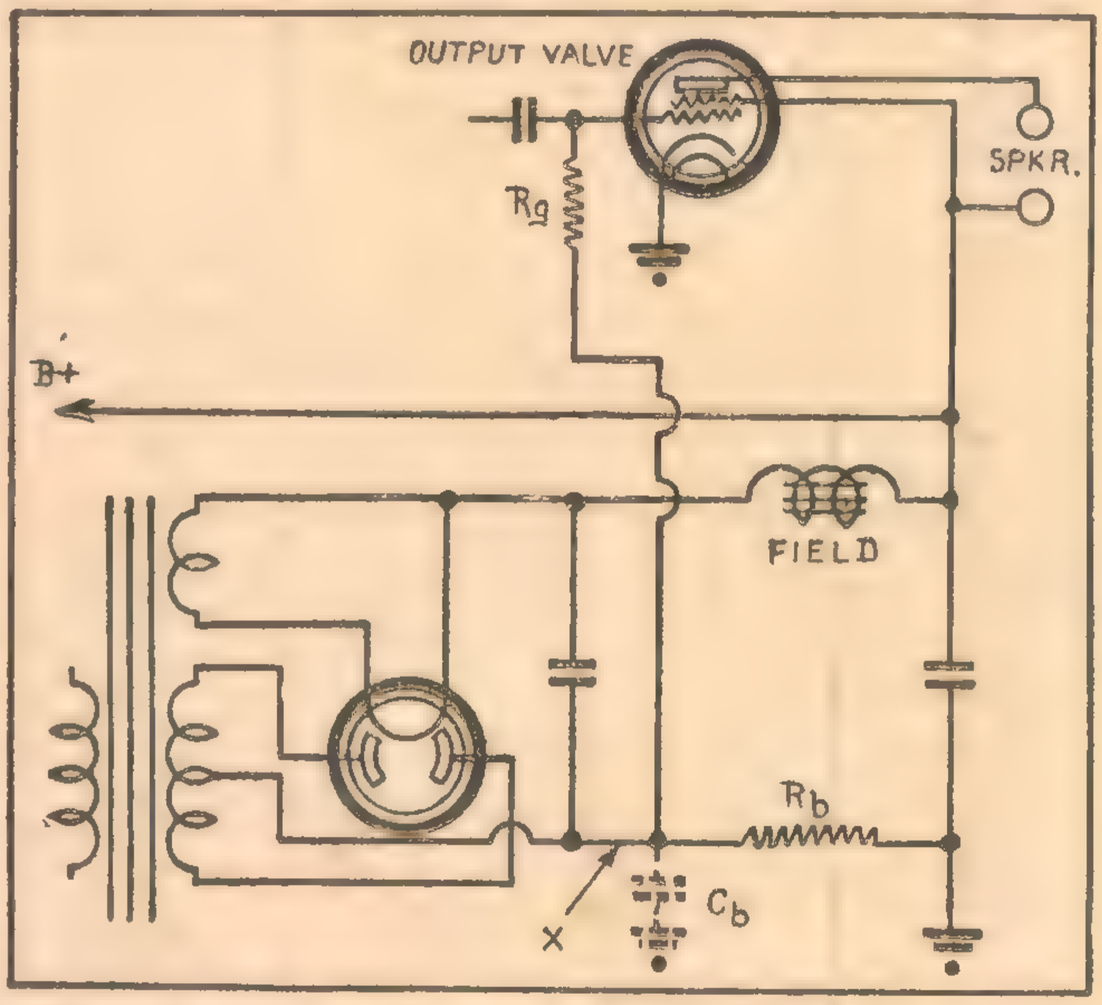


Figure 3. A typical back-bias circuit, which is often used in place of self or cathode bias. The differences are sufficiently obvious to allow a relatively inexperienced enthusiast to pick out which system is used in any particular receiver.

It is necessary to appreciate this practice in order to understand the reason for this connection. In other respects the function and operation of the circuit is identical to the conventional cathode bias arrangement of figure 1.

A point worthy of special mention is that, in some receivers, the output valve is deliberately overbiased to a greater or lesser extent in order to reduce the current drawn fom the high tension supply. An instance of this is the "Little General" receiver, in which the bias was sufficient to keep the total current drain within the 40 milliamp limit imposed by the power transformer.

When receiver is modified to take another type of output valve, it is obviously desirable to overbias the replacement valve also in order to maintain the total current within the same limits.

OVER-BIASING VALVE

One can be guided along these lines by a careful observation of the bias resistor which has to be replaced. For example, a type 42 or 6F6-G output valve may be found to have a cathode bias resistor of, say, 500 ohms, as compared to the calculated value of 410 ohms. This means that the resistor has been increased by 22 per cent. above the calculated value.

If the valve had to be replaced by, say, an EL3-NG, it would be a wise precaution to increase the value of the new cathode bias resistor by the same percentage. This would work out at about 183 ohms—giving a choice of either 175 or 200 ohms as a practical value.

All this may sound a little involved at the first reading, but it is really quite simple when you get the hang of it. So much then for cathode bias.

The second popular bias arrangement is known as back-bias or semi-fixed bias. The basic circuit arrangement is shown in figure 3.

It will be noted that the cathode of the valve connects directly to the chassis. The grid, on the other hand, returns to the centre-tap of the high tension winding on the power transformer, which is connected to earth through a resistor.

Observation of these differences makes it fairly easy, even for less experienced enthusiasts, to pick which of the two bias systems is used in a receiver.

CATHODE AND BACK-BIAS

If there is a resistor in the cathode circuit of the output valve and the grid returns to earth, it is a sure sign that cathode bias is used. If, however, the cathode is connected to earth and the grid returns to some network connected with the high tension power supply, it is a safe bet that back-bias is employed.

If a resistor is connected between the centre-tap of the high tension winding and the chassis (Rb in figure 3) it has to carry the whole high tension current of the receiver. Therefore, a voltage is developed across the resistor in proportion to its resistance and the amount of current flowing.

The direction of flow is such that the end of the resistor connected to the transformer is negative with respect to the chassis. It follows that, if the cathode of the output valve is connected to the chassis, and the grid return resistor is connected to the point of negative potential, negative bias will be applied to the grid.

The condenser Cb, shown dotted in figure 3, is often included to minimise hum due to ripple in the bias voltage. In some cases a more elaborate decoupling network is used, involving a resistor in series with the grid return resistor

and a condenser bypassing the junction of the two to earth.

However, this is in the nature of a refinement and does not alter the basic operation of the circuit. The cathode still returns to earth and the grid to the point of negative potential.

Previous remarks in regard to the value of Rg still apply. Strictly speaking, owing to the fact that the bias is other than straight-out cathode bias, the maximum permissible value of Rg is lower, but this point is seldom observed in practice and the conventional 0.5 megohm grid return resistor is retained.

It will be clear from the foregoing explanation that the bias developed is not due solely to the cathode current of the output valve, but is developed by the current drain of the entire receiver flowing through the back-bias resistor.

TOTAL CURRENT DRAIN

Therefore, in order to calculate the value accurately, it is necessary to estimate the total current drain of the receiver. This is not quite as simple as might first appear.

In the first place, it is not satisfactory to note the valves used, to refer to a chart and then simply to add together all the figures of current drain found therein. As far as the valves themselves are concerned, the resultant figure would almost certainly be too high, because it would take no account of the reduced current drain of the valves in the tuner with a typical input signal, nor the reduced current drain of valves used under resistance coupled conditions.

Also, there is the current of the voltage divider to be considered or of other bleed resistors.

Knowing the circuit, an experienced man can estimate the current drain of a receiver within a milliamp or so, but it is not so easy for the amateur. How then can the amateur calculate the value of back-bias resistor if he cannot determine the total current drain?

Fortunately, there is a simple way out of the difficulty which gives fairly accurate results.

We stated previously that the usual run of a-c pentode output valves used in broadcast receivers for many years all draw about the same total cathode current. On this assumption, it follows that the replacement of one of the usual pentode output valves with another will not materially affect the total current drain, provided that the bias for the output valve is changed to suit.

SIMPLE PROPORTION

The problem then boils down to a simple proportion. If the total current drain is unaffected, the bias resistor will have to be changed in direct proportion to the relationship of the bias required for the replacement and for the original valve.

Thus, a receiver using a 42 may have a back-bias resistor of, say, 300 ohms, providing the nominal bias voltage of —16.5 volts. If it has to be replaced by another type drawing similar cathode current, but requiring only —6.0 volts bias, the resistor would have to be reduced in the proportion of 6 to 16.5. In the case in point, this would work out at near enough to 109 ohms.

Conversely, if a valve requiring —6 volts bias is replaced by one requiring —16.5 volts, the bias resistor would have to be increased in the proportion of 16.5 to 6. Note that this simple calculation only holds where the replacement does not materially alter the total current drain of the receiver.

ANOTHER TYPE OF BACK BIAS CIRCUIT

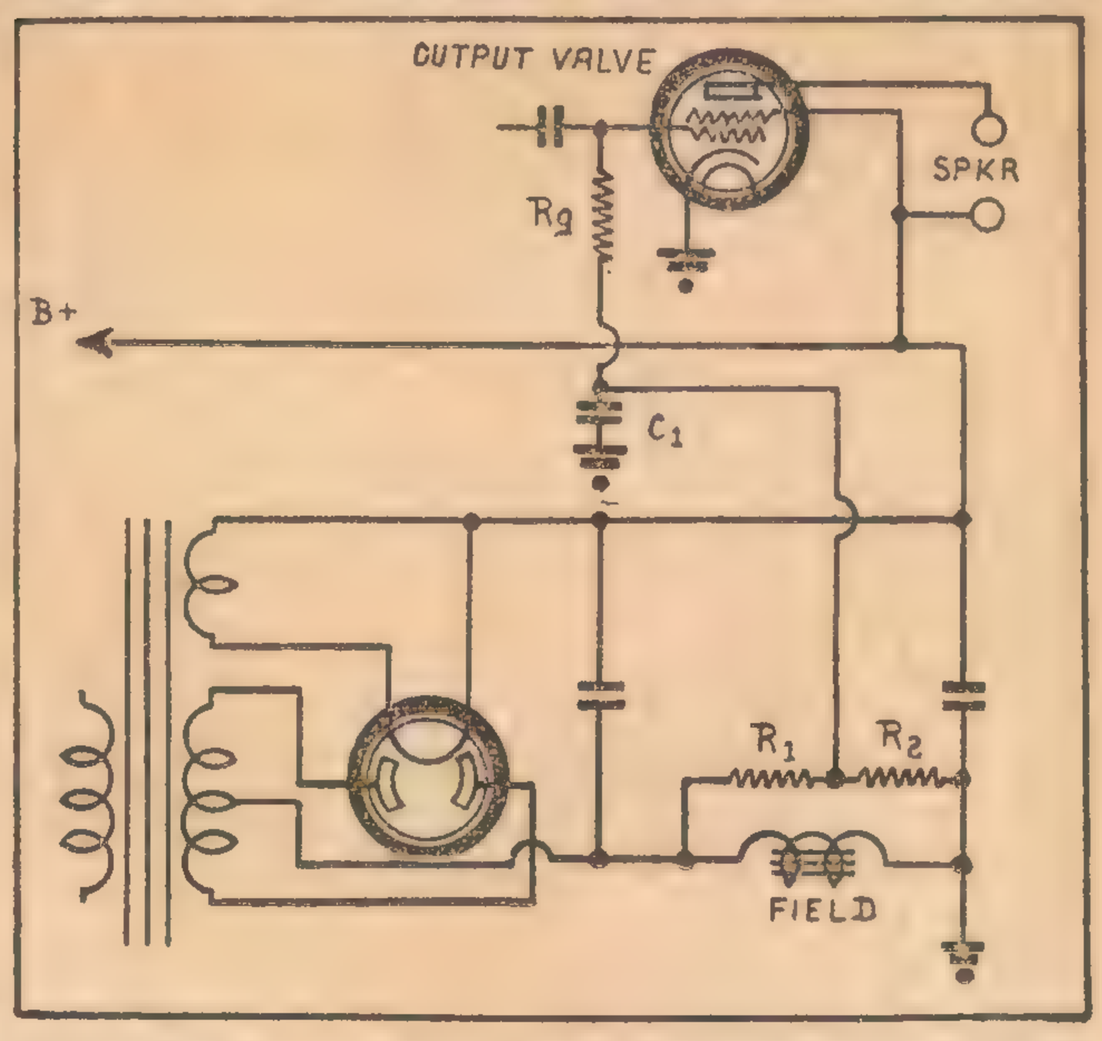


Figure 4. A bias circuit which is not common but which is worthy of mention is that in which the field is connected in series with the negative arm of the power supply, the bias for the output valve being picked up from a voltage divider connected in parallel with it. Calculations are a little more involved, but still not very formidable.

One useful point about the calculation is that it automatically takes into account any overbiasing of the original valve for reasons of economy of current drain.

Back-bias and the associated calculations apply equally to directly and indirectly heated output valves. As far as the circuit is concerned, the only difference in figure 3 with a directly-heated valve would be the elimination of the cathode lead and a connection between the chassis and the centre-tap of the filament circuit.

ALTERNATIVE CIRCUIT

In some receivers the field coil will be found connected in series with the negative lead of the power supply, instead of in the positive lead, as shown in figure 3. The alternative point of insertion is shown as point "X." This does not affect the calculations in any way and is simply an alternative method of wiring the filter circuit.

A few receivers may be found with the field connected in the negative power supply lead and the requisite bias picked up from a high resistance divider network connected in parallel with it. The circuit arrangement is shown in figure 4.

Fortunately, perhaps, this circuit arrangement is not common, for the calculations are rather more tricky. Correct approach is first to estimate the total current drain of the receiver, then, knowing the resistance of the field coil, to work out the voltage drop across it. Having calculated the voltage drop, it is then necessary to devise a voltage divider network which will give the correct negative bias voltage for the particular output valve.

CALCULATION

For the more experienced enthusiasts, this would present no great problem. However, watch out that you retain something like the same total d-c resistance in the divider network. If the total resistance is reduced to one-half or one-third the previous figure, the condenser C1 may not be able to filter out the ripple sufficiently.

If there is any difficulty in estimating the total current drain of the receiver, the new value of the divider network may be arrived at by a proportion sum, assuming as before that the total current drain of the receiver remains the same after the replacement output valve has been installed.

By observing the ratio of R2 (adjacent to earth) to the sum of R1 and R2, it will be discovered that the original divider network picks off a certain definite fraction of the voltage across the field for the negative grid bias. For the sake of argument, let us assume that the original valve was a 6F6-G (requiring a bias of —16.5 volts) and

(Continued on Next Page)

that the divider network picked off one-seventh of the voltage across the field coil.

If it had to be replaced by an EL3-NG (requiring —6.0 volt bias), the fraction would have to be reduced by the factor 16.5/6.0. We would thus have

1/7 ÷ (16.5/6.0),
= 1/7 × 6.0 ÷ 16.5,
= 6/115.5,
= 1/20 approx.

In other words, the divider network would have to be redesigned to pick off slightly more than one-twentieth of the voltage across the field for bias for the EL3-NG.

In the alternative case, where the replacement valve required more bias than the original, a larger fraction of the voltage across the field would have to be picked off by the divider network.

COMBINED CIRCUIT

A circuit arrangement which is sufficiently rare to warrant only passing mention is that in which bias for the output valve is by a combination of cathode and back-bias, part being picked up in the cathode circuit and part from a back-bias network.

In most cases the back-bias is provided primarily for the earlier valves in the receiver and applied to the output valve grid only because a few volts happens to be available and because it allows the use of a smaller cathode resistor. Without going into further detail, it is wise to leave the back-bias network alone, increasing or decreasing the cathode bias resistor as required.

The foregoing discussion has been limited in its scope to ordinary single class A power pentodes, as used almost without exception in domestic mains-operated receivers. The remarks also apply in general to receivers and amplifiers using output pentodes in push-pull class A operation.

In the case of receivers and amplifiers using class AB1 and class AB2 pentodes, especially with unequal plate and screen voltages, the replacement of one type with another is liable to involve other major considerations and should not be attempted without a complete understanding of the problems involved.

Before passing on to discuss individual valve types, it may be as well to make mention of the matter of optimum load impedance.

LOAD IMPEDANCE

As is well known, manufacturers specify certain definite values of load impedance for different output valves and different operating conditions. In general, it is wise to observe these values, avoiding a mismatch greater than about 25 per cent.

Fortunately, all the ordinary pentode output valves discussed in this article require the same order of load impedance, so that it will not normally be necessary to change the output transformer on the speaker when interchanging any of the types mentioned herein.

Following this general discussion, we can now pass on to mention individual valve types. For each type, the socket diagram is shown, the same terms being used to denote individual pin connections.

When interchanging any of the valves mentioned, which happen to require a different socket, carefully disconnect the wiring from the original socket, noting which leads go to the plate pin, which to the grid pin, and so on. When the new socket is installed, the appropriate leads can then be taken to the new plate pin, the new grid pin, and so on.

SOCKET FOR THE 47

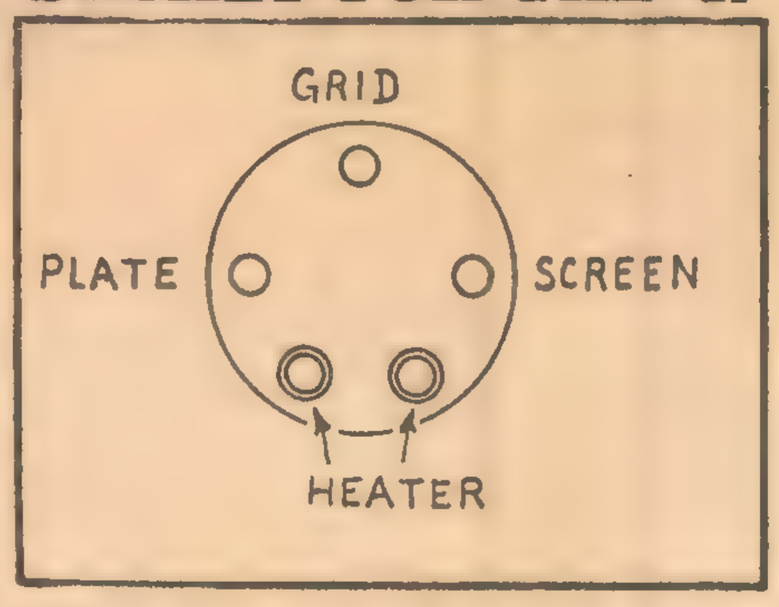


Figure 5. Here are the socket connections for the 47, viewed from underneath the chassis. Note that there is no cathode pin.

Taking the American valves first and in order as they appeared, the first widely used output pentode was the 47. Socket connections are shown in figure 5.

TYPE 47 PENTODE

The valve requires a 5-pin socket and is of the directly heated variety, having no cathode. As explained previously, emission is from the surface of the filament and the filament return is, therefore, important.

With self or cathode bias, the bias resistor and associated by-pass must be connected between the mid point of the heater circuit and chassis. The mid point of the heater circuit may either be the centre-tap of the 2.5 volt supply winding, or the mid point of a centre-tapped resistor of about 20 or 30 ohms, shunted across the filament terminals. The latter arrangement is depicted in figure 2. Special centre-tapped resistors are sold for this purpose.

In many cases, the same heater winding which supplies the 47 is also used to supply the heaters of other valves in the receiver. It follows that, when cathode bias is used for the 47, the heaters of the other valves must be at a positive potential with respect to chassis. Because they are invaraibly of the indirectly heated type, this is of no consequence.

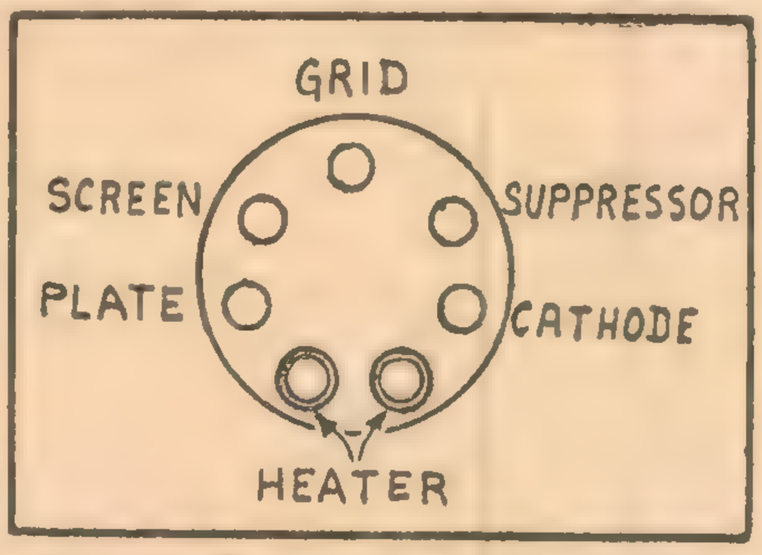


Figure 6. The socket connections, viewed from underneath the chassis, of type 59. Note that the suppressor is brought out to a separate pin.

In the case of back-bias, the heater circuit must be earthed by means of the centre-tap just mentioned.

When replacing a 47 with an indirectly heated valve having a cathode. the heater circuit must be given special attention. If cathode bias is used in the particular receiver, the cathode bias resistor and the by-pass condenser must be disconnected from the heater circuit and connected instead to the cathode pin of the new valve. The heater circuit may then be earthed by means of the centre tap.

If, on the other hand, back-bias is used, the heater circuit can remain the same, but an additional connection must be made between the cathode pin and earth. The object of these modifications is to redirect the cathode current through the cathode circuit instead of through the filament circuit for the 47.

IF INSTALLING A 47

If a type 47 is used to replace an indirectly heated valve—and this is not unthinkable under the present conditions—the original cathode connection must be eliminated and the wiring transferred to the filament circuit.

With cathode bias, this means that the heater circuit has to be isolated from chassis and the bias resistor and condenser transferred from the original cathode pin to the centre-tap of the heater circuit. It is essential to break any existing connection between the heater circuit and chassis so that bias resistor will not be shorted out. It is common practice to earth the heater circuits in a receiver, either near one of the valve sockets or on the panel of the power transformer.

If back-bias is used, the filament of the 47 will have to be returned to chassis, either through a centre-tapped resistor or through the centre-tap of the heater winding. It is quite unsatisfactory to have one side of the heater winding earthed, even though this may have been done with the former indirectly heated type.

OPERATING CONDITIONS

The 47, under typical 250-volt conditions, draws a total plate and screen current of 37 milliamps and requires a bias of —16.5 volts. Cathode bias resistor for this type is 450 ohms. A value of 400 or 425 ohms could be used in an emergency, but it is as well to adhere to the correct figure.

Plate load is 7000 ohms, which is similar to that used for most other common a-c power pentodes.

In one respect, the directly heated filament of the 47 has an advantage, in that it reaches operating temperature just as quickly as the filament of the usual directly heated rectifier. Because the valve commences to draw current immediately after the receiver is switched on, there is no pronounced rise in voltage during the warming-up period and the condensers are thus protected. This feature is especially valuable in these days when neither wet electrolytic condensers nor bleed resistors are readily available.

MULTIPLE PURPOSE 59

After the 47 came the 59, a valve designed to function either as a class A or class B triode or as a class A pentode, according to the manner in which the respective grids were used. In practice, it was used mainly as an output pentode, superseding the 47.

Type 59 has a so-called medium 7-pin socket, which is considerably larger than the small 7-pin used by such valves as the 6A7 and 6B7. Socket connections are shown in Figure 6.

The valve is indirectly heated, so that there is the expected cathode pin. In addition, the suppressor grid is brought out to a separate pin; in all other output pentodes, the suppressor and cathode are connected internally within the valve.

Used as a class A power pentode, the suppressor of the 59 is always connected to the cathode at the socket. When

replacing a 59 with any other type, the suppressor connection may simply be ignored, remembering that, in all other types, the suppressor is connected internally within the valve.

If you should happen to be installing a 59 in a receiver in place of any other type, remember to connect the suppressor pin to the cathode at the socket.

Under 250-volt conditions, cathode current of the 59 as an output pentode is 44 milliamps, and the bias required is —18 volts. The bias resistor works out at 410 ohms. Optimum plate load is 6000 ohms, so that a speaker intended for a 59 would be quite OK with any one of the other ordinary pentode output valves.

2.5V TYPE 2A5

The 2A5, introduced soon after the 59, is the 2.5 volt electrical equivalent of the more recent 42 and 6F6-G. It is quite conventional, and requires no special comment. Cathode current under 250 volt conditions is 40.5 milliamps, bias —16.5 volts, and bias resistor 410 ohms.

One point which is worthy of mention here is that the 2A5 was one of the earliest valves for which figures of current drain are quoted for "no-signal" and "with signal" conditions. In the case of class A pentodes, it is as well to calculate the value of the cathode bias resistor on the "no-signal" current drain figures.

The 47, 59, and 2A5 are the three well-known 2.5 volt output pentodes. Because they have the same heater voltage rating, they may be interchanged most conveniently. At the moment of writing, the 59 is virtually unobtainable, and the 2A5, by reason of an interruption in local production, is in much the same category. The 47 appears to be available in limited quantities, and may therefore come in very handy as a replacement output valve in 2.5 volt a-c receivers.

In the event of there being no 2.5 volt output pentodes available, the only course left open is to use a 6.3 volt replacement valve, installing a small filament transformer to supply the heater.

FILAMENT TRANSFORMERS

These transformers have been on sale for some time. The two primary leads should be connected to the respective mains leads where the latter connect to the main power transformer; the secondary leads are connected to the heater pins of the valve or valves to be supplied, as shown in Figure 8. It is usual to earth one side of the heater circuit, in order to minimise hum.

A type of filament transformer which may be seen in greater numbers in future is the auto transformer, with a single tapped winding, which can be arranged to step up or step down the existing heater voltage as required.

The 42 was the first of the 6.3 volt output pentodes to be widely used in this country. Apart from the heater voltage, it is identical to the 2A5. Thus, the two can be interchanged one for the other, with no other alteration to the receiver, other than the provision of the requisite heater voltage. This is a handy point to keep in mind.

Type 41 is a rather uncommon output valve which has identical base connections to the 42. It is sufficiently similar electrically to be regarded loosely as interchangeable, although, to be precise, the cathode current is 37.5 milliamps, the optimum bias —18 volts, and the bias resistor .80 ohms. When using a 41, it is just as well to provide the correct bias.

The octal-based equivalent of the 41 is the 6K6-G, which has the same base connections and bears the same relationship electrically to the octal-based equivalent of a 42, namely, type 6F6-G.

The 6F6-G will replace the 42 with nothing more than a change of socket. Socket connections for the 6F6-G and the 6K6-G are shown in Figure 9.

SOCKET CONNECTIONS FOR 2A5, 41, 42 &c.

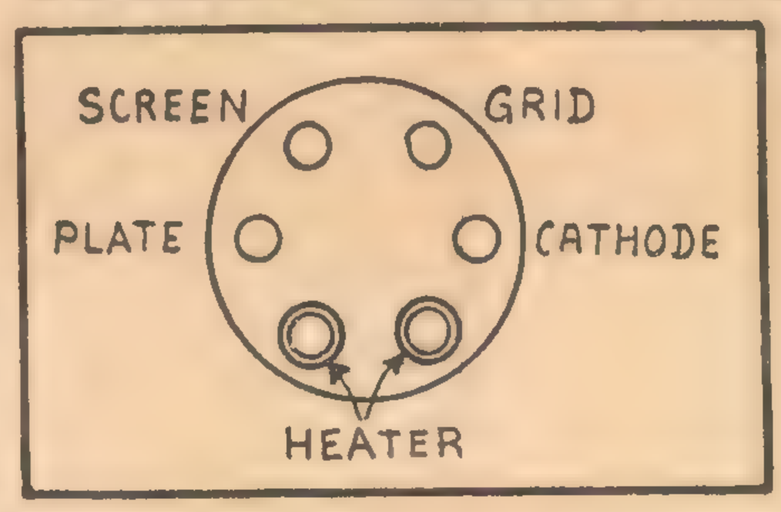


Figure 7. The connections to the six pin socket used for the 2A5. The pin connections are as seen from beneath the chassis. The same six pin socket is used for the 6.3 volt equivalent type 42 and for the lesser known type 41.

SIMILAR TYPES

Thus, we have a group of valves which are very similar electrically, and which can be interchanged without much trouble. The changes required may be (1) a change of socket, (2) a change of heater voltage, (3) a slight modification to the bias.

The valves concerned are the 47, 59, 2A5, 41, 42, 6F6-G, 6K6-G. In addition there are the lesser known metal and midget equivalents 6F6, 6F6-GT, 6K6 and 6K6-GT. Of these, the 2A5, 42, 6F6, 6F6-G and 6F6-GT are identical apart from heater voltage and/or socket. The 41, 6K6, 6K6-G and 6K6-GT are all similar, apart from the socket.

Types 6V6, 6V6-G and 6V6-GT are beam tetrodes which have been introduced and used more recently than the aforementioned types.

Under ordinary 250-volt conditions, the 6V6-G draws a cathode current of 49.5 milliamps, requires a bias of —12.5 volts and a bias resistor of 250 ohms.

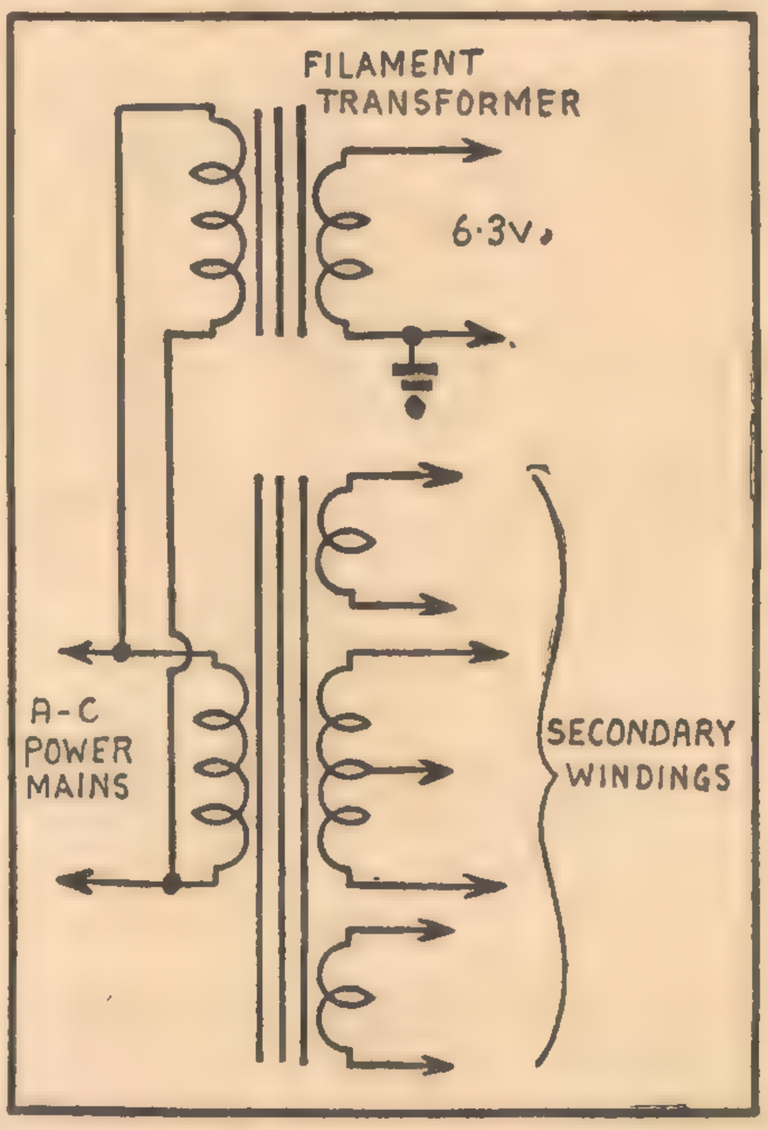


Figure 8. In cases where the only available replacement has a different heater voltage to the original valve, it may be necessary to add a filament transformer. Connections are as shown above.

It has the same base connections as a 6F6-G.

Speaking generally, a 6V6-G can be substituted directly for a 6F6-G in an ordinary receiver. The larger bias provided for the 6F6-G serves to reduce the plate current of the 6V6-G, so that it assumes characteristics very similar to those of the 6F6-G.

The same remarks apply to the replacement of any of the other ordinary output pentodes with a 6V6-G, although a change of socket and heater voltage may be required.

However, it does not follow that a 6V6-G may be directly replaced with one of the other valves mentioned. Most likely, the bias provided for the 6V6-G would be far too low and the new valve would draw excessive current. When replacing the 6V6-G with another valve, it is necessary to change the bias resistor to suit. The change may result in a slight rise of high tension voltage, which would not matter much with the 2A5, 42 or 6F6-G, but which is not altogether desirable with the 47, 41 or 6K6-G.

PHILIPS TYPE EL3-NG

At the time of writing, Philips type EL3-NG is the most easily obtainable of the ordinary output valves, and we have had many queries in regard to its use as a replacement type.

The EL3-NG draws a total plate and screen current of 40 milliamps, so that, as far as high tention drain is concerned, is quite a satisfactory replacement. The EL3-NG has the same socket connections as the 6F6-G, 6K6-G and 6V6-G. The EL3-N is electrically equivalent to the EL3-NG but has the continental "P" base. It is thus not as convenient as a replacement as the octal-based type.

Main point of note about the EL3-NG is the low value of bias required and the higher power sensitivity. Bias required under 250-volt conditions is —6.0 volts, the requisite bias resistor being 150 ohms.

Because of its higher power sensitivity, the installation of an EL3-NG in place of a less sensitive type may possibly lead to trouble with audio instability. This may take the form of a continuous burble or howl, or may be a continuous or intermittent oscillation at a frequency above the audio range, and therefore not heard in the speaker.

Oscillation within the audible range will be quite evident. Supersonic oscillation usually causes harsh, rattling sound on peaks of output well below the normal maximum output of the valve. It is not unlike grid current distortion in an ordinary amplifier, except that it becomes evident at a much lower level.

Instability is usually caused by stray coupling between the plate circuit of the output valve and an earlier point in the amplifier. It can often be overcome by rearranging the leads and components connected to the plate circuit of the

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CONNECTIONS FOR THE EL3-NG AND EL3-N

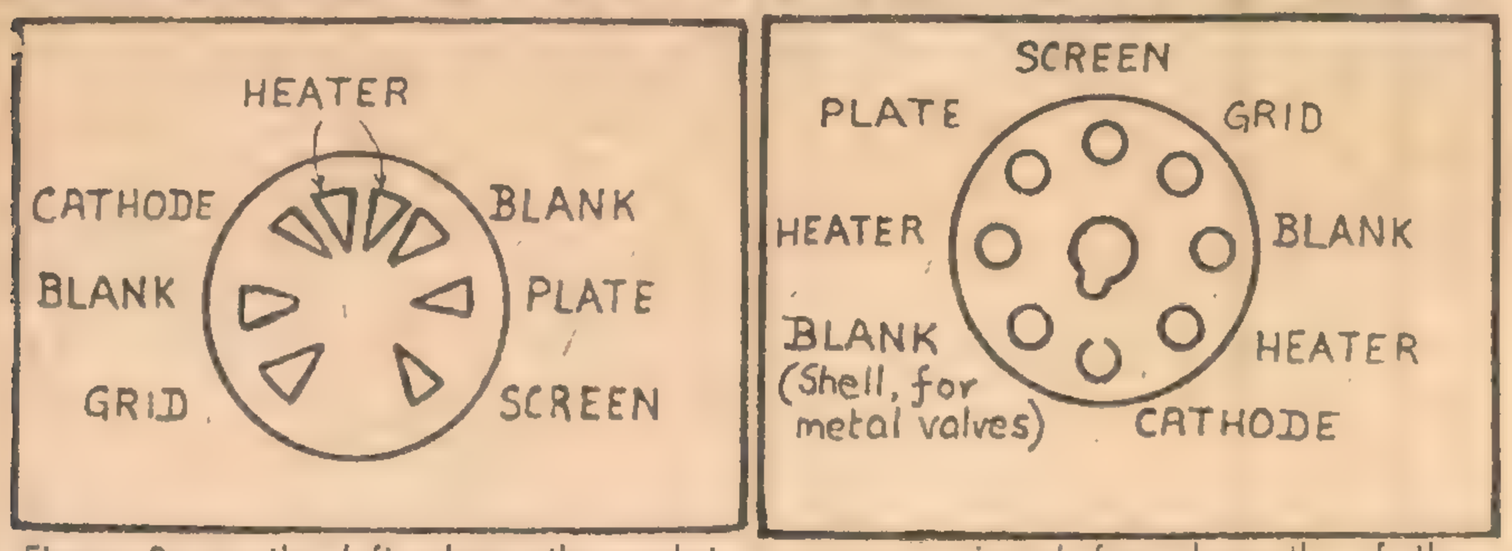

Figure 9, on the left, shows the socket connections viewed from beneath, of the EL3-NG. Figure 10, on the right, shows the connections for the EL3-N. The latter valve has a "P" type base, which does not always fit conveniently into a chassis drilled for an ordinary wafer socket.

output valve. If this does not overcome the trouble, shielding the plate lead may have the desired effect.

Other measures are to earth the frame of the loud-speaker to the receiver chassis and to by-pass the plate of the output valve to chassis with a condenser of about .002mfd. Alternatively, it may help to by-pass the plate of the previous amplifier stage to the chassis with a .00025mfd. condenser. A still further measure is to connect a grid stopping resistor in series with the grid and as close as possible to the valve socket. The value is not critical, and may be about 10,000 ohms.

CATHODE BY-PASS

Another idea, which has the effect of reducing the power sensitivity, is to omit the cathode by-pass condenser in the case of a cathode biased stage. This will not normally have any undesirable effect on the frequency response, but may reduce the gain sufficiently to render unnecessary some of the previously mentioned precautions. The various measures are illustrated in Figure 10.

It may be mentioned, in passing, that a single EL3-NG with a suitable power supply and speaker makes an excellent one-valve amplifier for a crystal pick-up. Readers will remember that we described an amplifier along these lines, but using a 6V6-G, in "Radio and Hobbies" for May, 1940, and December, 1941.

On a typical recording, the output from an ordinary crystal pick-up will load up an EL3-NG to just about full output. For the purpose, it is necessary to have an 0.5meg. potentiometer in the grid circuit of the EL3-NG, feeding the pick-up across the outer terminals and taking the grid to the moving contact.

An ordinary magnetic pick-up will work in a fashion in this manner, but the output is very much lower and the tone very much thinner than with a crystal pick-up.

IN AMPLIFIER PA-5

By way of experiment, we tried out an EL3-NG in the PA-5 amplifier, which was originally designed for a 6V6-G output valve. Only preliminary change made to the circuit was to reduce the cathode bias resistor for the output valve to 150 ohms. On switching on, the amplifier showed definite signs of instability for certain settings of the tone control. The trouble was overcome (1) by shielding the plate lead of the output valve, and (2) by increasing the plate by-pass of the second 6J7-G to .00025mfd. These measures were in line with our previous suggestions.

The Amplifier PA-5 was originally designed to use a 6V6-G under full class A conditions, drawing a cathode current of about 50 milliamps. The substitution of an EL3-NG, with its lower voltage and current ratings, caused the high tension voltage to ride to just over 300 volts.

Maximum permissible voltage between screen and cathode of the EL3-NG is 275 volts, so that 300 volts is definitely excessive. The valve may certainly function well enough for a time under these conditions, but life would suffer as a result.

Where this problem is met in a receiver or amplifier, it is as well to try and reduce the voltage either by adding a bleed resistor to make up for the lower current drain or by inserting a resistor in series with the field to increase the voltage drop in the filter system.

In the case of amplifier PA-5, easiest way out would be to wire a 25,000 ohm voltage divider—if you have one—between B-plus and chassis. Failing that, five 5000 ohm resistors connected in series would serve the purpose. Still another measure, which has the admitted disadvantage of lowering the heater voltage somewhat, is to connect the power mains across the 260-volt tapping on the power transformer.

Steps to reduce the high tension voltage will normally only be required when replacing a 6V6-G, since all other valve types mentioned draw much about the same cathode current.

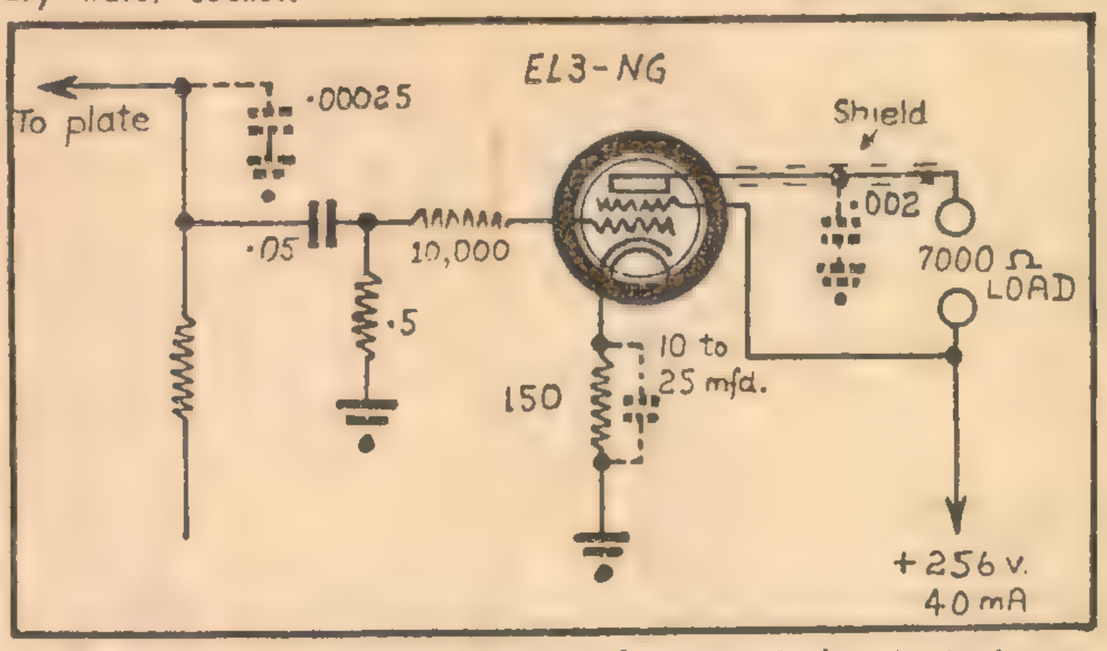

Figure 11. The circuit constants for a typical output stage using the EL3-NG valve. When used as a replacement valve, some of the components shown dotted may have to be added to ensure stability of operation.

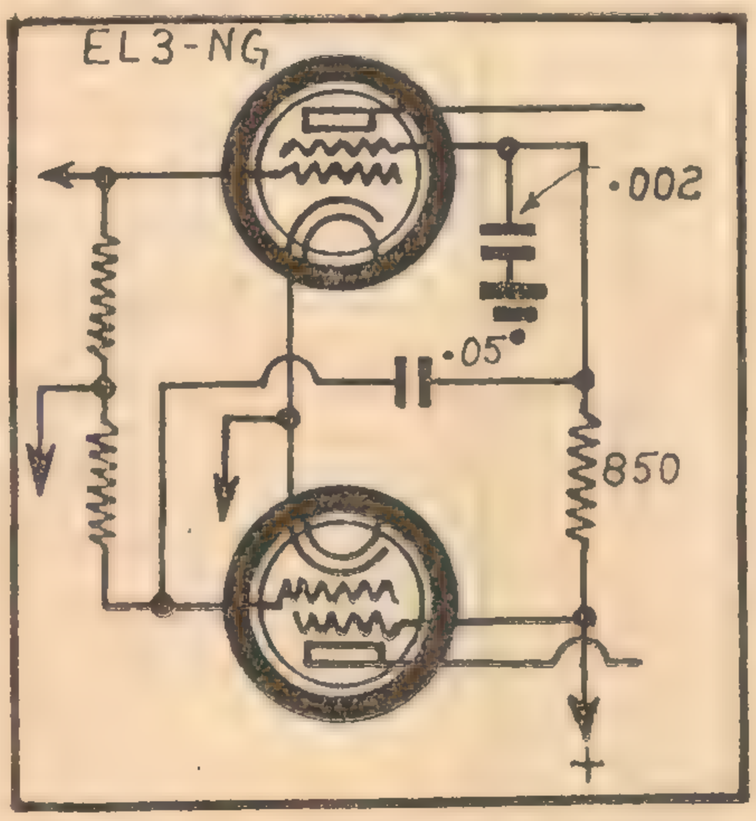

Figure 12. For the system of push-pull output, which has been used quite a lot lately, the series screen resistor for the upper EL3-NG is 850 ohms.

EFFECT ON FEEDBACK

Some readers have asked about the effect of interchanging output valves on feedback networks which may be incorporated in a receiver. Unless the reader is in a position to work out feedback factors and the like the best advice we can give is to leave the feedback circuit as it is.

With all valves except the EL3-NG, the difference in gain is not sufficient to cause any marked change in the functioning of the feedback system. If an EL3-NG is installed, the effect may be to increase the feedback slightly, without making a marked difference in the general performance.

Similarly, the replacement of an EL3-NG with another type may reduce the feedback and slightly again without greatly affecting the performance. This is a rather general statement but it seems to work out in practice. In apparatus of a special nature, a more meticulous approach to the question may be warranted.

We checked the operation of PA-5 amplifier and also the 42/43 Standard receiver with EL3-NG valves in the output, and found that there was no necessity to modify the feedback circuit.

PUSH-PULL CIRCUIT

Many readers have already written to us asking what is the optimum value of the series screen resistor for the EL3-NG when used in a push-pull output circuit similar to that employed in the PA-3 amplifier and 42/43 Standard receiver.

We duly checked this with the aid of an oscillograph, and found it to be 850 ohms under ordinary 250-volt conditions. This compares to 1500 ohms for the 6V6-G, 2500 ohms for the 6F6-G and similar types, and a purely "guesstimated" value of 2000 ohms for the 47 and 59.

The required resistor of 850 ohms is not a standard value, and, if necessary, one of 750 or 800 ohms will serve quite well. Even 1000 ohms would probably do in most cases, but it is preferable to err on the side of too little rather than too much resistance in this position.

This figure, together with the previous discussion in regard to bias values, should make it possible for readers to incorporate EL3-NG valves in the PA-3 amplifier or in such receivers as the "T.R.F. Quality Six" and the "42/43 Standard."

WORK OUT YOUR OWN MATHS PROBLEMS

As promised in last month's issue we now propose to commence the discussion of mathematical calculations as applied to alternating current circuits. These calculations you will find are slightly more involved than those previously dealt with in connection with D-C circuits and, in addition, it will be necessary to learn the meaning of quite a few terms not previously encountered.

by C. E. Birchmeier

CONSEQUENTLY, we intend making this article more of an introduction to the whole subject, discussing the generation of alternating current itself, as well as explaining some of these new terms. Then, when they are encountered in later articles, no doubts will exist as to their correct meaning.

So far, in these articles, we have been considering mainly direct voltage and current circuits wherein the voltages do not change their polarity nor do the currents their direction of flow. However, with alternating circuits, we find a somewhat different situation.

As the name implies, an alternating current (usually) abbreviated to A.C. or A-C) does not flow continuously in the same direction but the voltage and current change their polarity and direction of flow periodically. Because of this, D-C formulae are not always directly applicable in A-C circuits.

GENERATION A-C

At this juncture we will very briefly describe how an alternating current is produced or generated. In figure 1, we have represented an alternator in its basic form, consisting of a loop of wire, having its ends connected to two "slip rings" and able to rotate within the magnetic field formed by the permanent magnets M-M.

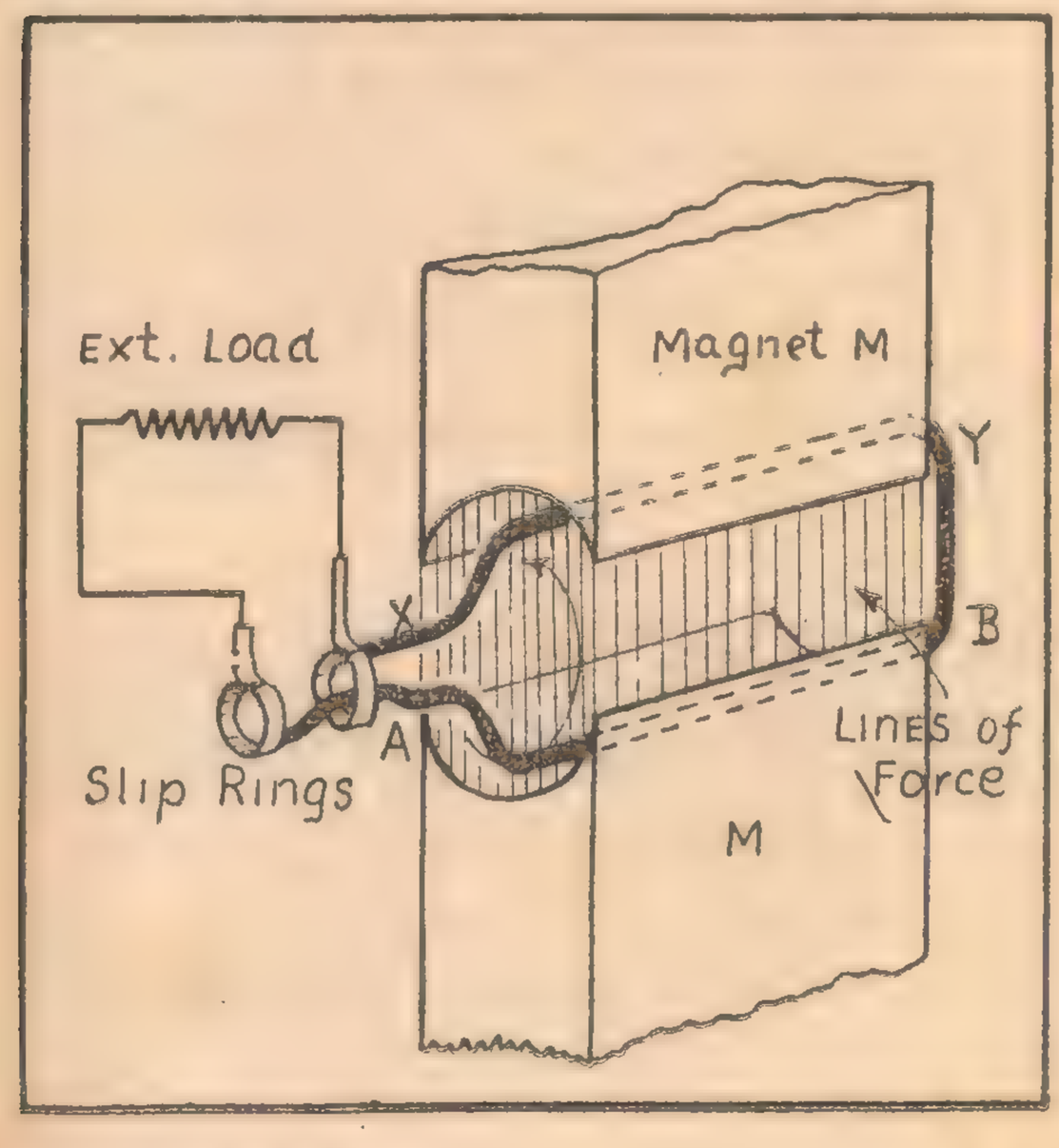

Figure 1. An elementary alternating current generator comprising a loop of wire, which revolves within a magnetic field constituted by the magnets M-M. This should be studied in conjunction with figures 2, 5 and 6.

Now there is an electrical law which states that, if a conductor loop is rotated in such a manner that it cuts or moves across the magnetic lines of force existing between two unlike pole pieces, then a current will be induced in that loop; when the conductor moves parallel with the lines of force, no current will flow. Here then is what happens in our case when the loop is rotated.

As one side moves away from the lower pole piece, an E.M.F. will be generated in it (due to the lines of force being cut) in the direction of, say, B to A. At the same time, the other side will be moving away from the upper pole piece, thus cutting the lines of force in the opposite sense, with the result that the E.M.F. developed will be in the opposite direction to that in A-B, that is, from X to Y.

Thus the two currents are, in effect, moving the same way in the conductor and so add together, forcing a current through any external circuit connected to the slip rings.

Now when the loop approaches a position of 90 deg. from that shown, it will then be in a plane approximately at right angles to the magnetic field, in which case no lines of force can be cut or crossed; thus, little or no E.M.F. will be developed.

As the coil A-B moves on toward the upper pole piece, it will again start cutting lines of force inducing a current, which will now flow from A to B, that is, in opposite direction to the previous case. Similarly, in the side X-Y, it will be directed from Y to X. This complete reversal of direction of the generated current—and hence the E.M.F. applied to the external circuit through the slip rings—is due to the changed position of the loop with respect to the lines of force, which remain fixed.

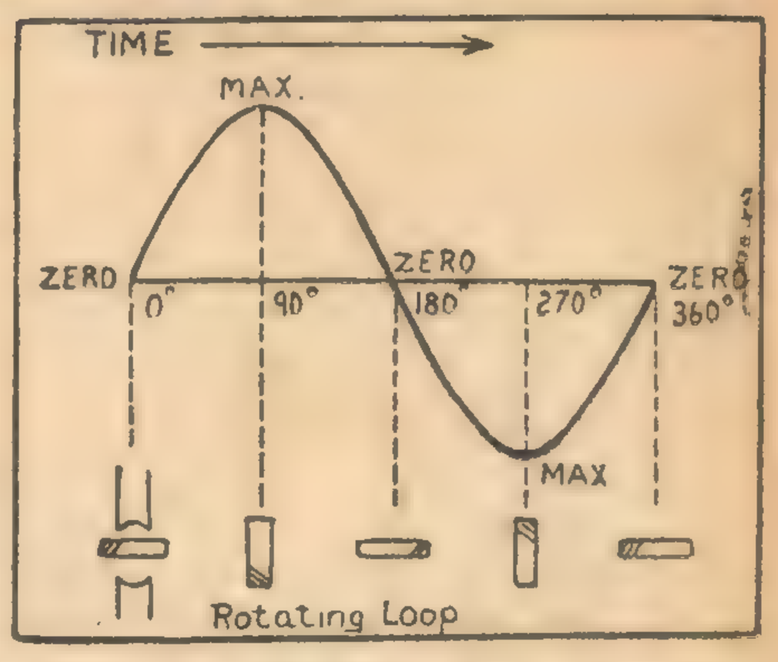

Figure 2. Illustrating the relationship between the position of the loop and the instantaneous value of the current induced in it.

CONTINUALLY CHANGING

As the loop continues to rotate, the current builds up in this reverse direction until the loop is in a plane parallel to the lines of force; thereafter, the current falls away again, becoming zero at the instant when the coil is again in a plane at right angles to the lines of force and 270 degrees removed from its starting point.

Further rotation causes the current to build up in the original direction of flow, reaching a peak when the loop has turned through an angle of 360 degrees back to its original position. Thereafter, during the second rotation, the current falls to zero at 90 degrees, changes direction, rises to a maximum at 180 degrees, falls to zero at 270 degrees, changes direction again and rises to a maximum at 360 degrees. So the whole process is repeated again and again, while the loop is being rotated.

A current, which alternates or changes its direction of flow periodically, is known as an alternating current. The associated E.M.F. is known as an alternating electromotive force, or, more loosely, as an a-c voltage.

SOME NEW TERMS

The manner in which an alternating voltage or current varies with time is depicted in figure 2. The position which the loop may occupy in respect to the magnetic field is also shown.

It should be noted that the E.M.F. is continually changing and if we wish to indicate its instantaneous value, we must state it as for a given instant only. At any other instant it may be greater or less than this value. However, more will be said of this further on in the article.

The pure and basic form of an alternating current wave is referred to as a sine wave. The implication of this term

SCHEMATIC CIRCUIT DIAGRAM of the ALL-WAVE BATTERY THREE

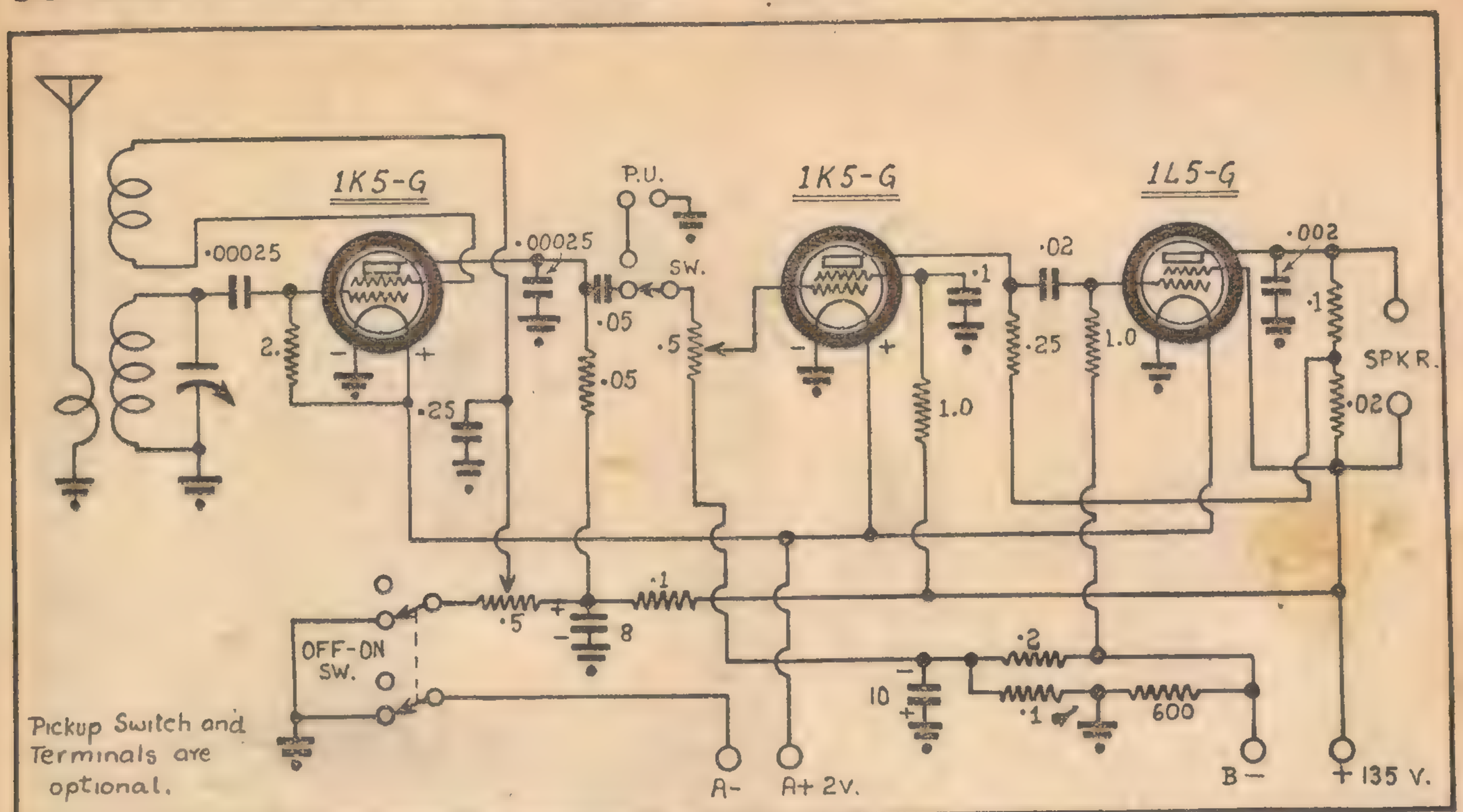

Figure 2. Here is the complete schematic circuit diagram of the receiver. Note the novel reaction circuit and the back-bias system. The Off-On switch is a necessary item, although it was not included in our receiver, which was built purely for experimental purposes. The pick-up switch is quite optional and may be omitted if not required.

coupled to the screen of the detector, instead of to the plate, as is usual. This scheme is apparently not an entirely novel one, although it is not one we have seen used for many years. Actually, one of our technical staff recalled using the circuit back about 1932 in a short-wave receiver.

What is probably more unique is the combination of screen reaction with the screen potential control. Connected between a source of high tension supply and earth, the potentiometer permits a continuously variable control of the screen voltage, the lower limit being zero volts.

EASY TO ADJUST

This wide range of control makes it particularly easy to adjust the reaction circuit, since one can wind on a liberal number of reaction turns and be quite sure that the screen potentiometer will limit regeneration if it is turned back far enough.

This is not true of the more usual condenser type of reaction control where the number of reaction turns has to be adjusted more or less critically with respect to the maximum and minimum capacitances of the reaction condenser.

In this circuit there is probably an optimum relationship between reaction turns and potentiometer setting, but it is not likely to be critical.

At the present time, this form of reaction control has the additional advantage that potentiometers are probably easier to obtain than reaction condensers. The control should be in good condition so as not to be noisy when rotated; however, any of the ordinary modern controls should be satisfactory in this respect. The screen bypass on the moving contact helps considerably to mask the effect of roughness in the resistance element.

Connection of the control across the high tension circuit makes for most effective control of screen potential. It has the disadvantage that there is a slight bleed current from the B batteries. With the 0.5 megohm potentiometer specified in the circuit, this bleed current is only a fraction of a milliamp and is of no consequence while the receiver is in operation.

However, it would eventually run down the B batteries if it were allowed to flow continously. The Off-On switch should, therefore, be arranged to break the circuit through the potentiometer, either by interrupting one B battery lead or by breaking the potentiometer circuit as shown in the schematic diagram.

This will normally require a double-pole Off-On switch, the second set of contacts serving to break the filament circuit. The desired result may be achieved by bringing the leads through a normal battery plug and socket, which can be removed from the receiver when the latter is not in use.

By more critical adjustment of the reaction circuit, it may be possible to use the screen control simply as a variable series resistor, the remote end having no connection to chassis. This would avoid the complication of the bleed current but would restrict the range of control of the potentiometer.

AN EXCELLENT CIRCUIT

As the reaction circuit is shown, it is particularly easy to handle. In fact, as far as our memory serves us, it is the best reaction circuit we have ever had anything to do with.

In our experimental set, there was absolutely no sign of "ploppiness," the detector sliding smoothly in and out of oscillation. Nor was there any appreciable lag in the control, the detector coming out of oscillation at practically the same setting of the control as that at which oscillation commenced.

(Continued on Page 33)

YOU WILL NEED THESE PARTS:

1 chassis, 5⅞ x 7 x 2 (approx.).
1 small tuning dial.
1 single gang tuning condenser.
3 plug-in coil formers, 1¼in. dia. ribbed.
1 10 mfd electrolytic condenser, 40 p.v.
1 8 mfd electrolytic condenser, 525 p.v.
1 .25 mfd tubular condenser.
1 .1 mfd tubular condenser.
1 .05 mfd tubular condenser.
1 .02 mfd tubular condenser.
1 .002 mfd mica condenser.
2 .00025 mfd mica condensers.
1 2 meg resistor.
2 1 meg resistors.
1 .25 meg resistor.
1 .2 meg resistor.
3 .1 meg resistors.
1 .05 meg resistor.
1 .02 meg resistor.
1 600 ohm, W.W. resistor.
2 0.5 meg potentiometers.
WINDING WIRE: Small quantities of 24 gauge, 32 gauge and 40 gauge enamel.
SOCKETS: 1 6-pin, 3 octal.
VALVES: 2 1K5-G, 1 1L5-G.
BATTERIES: 3 45v Superdyne B batteries, 1 2v A battery.
SUNDRIES: 3 knobs, 1 valve can, 2 terminals, 2 small grid clips, hook-up wire, braided wire, nuts and bolts.

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REAR VIEW OF THE BATTERY RECEIVER

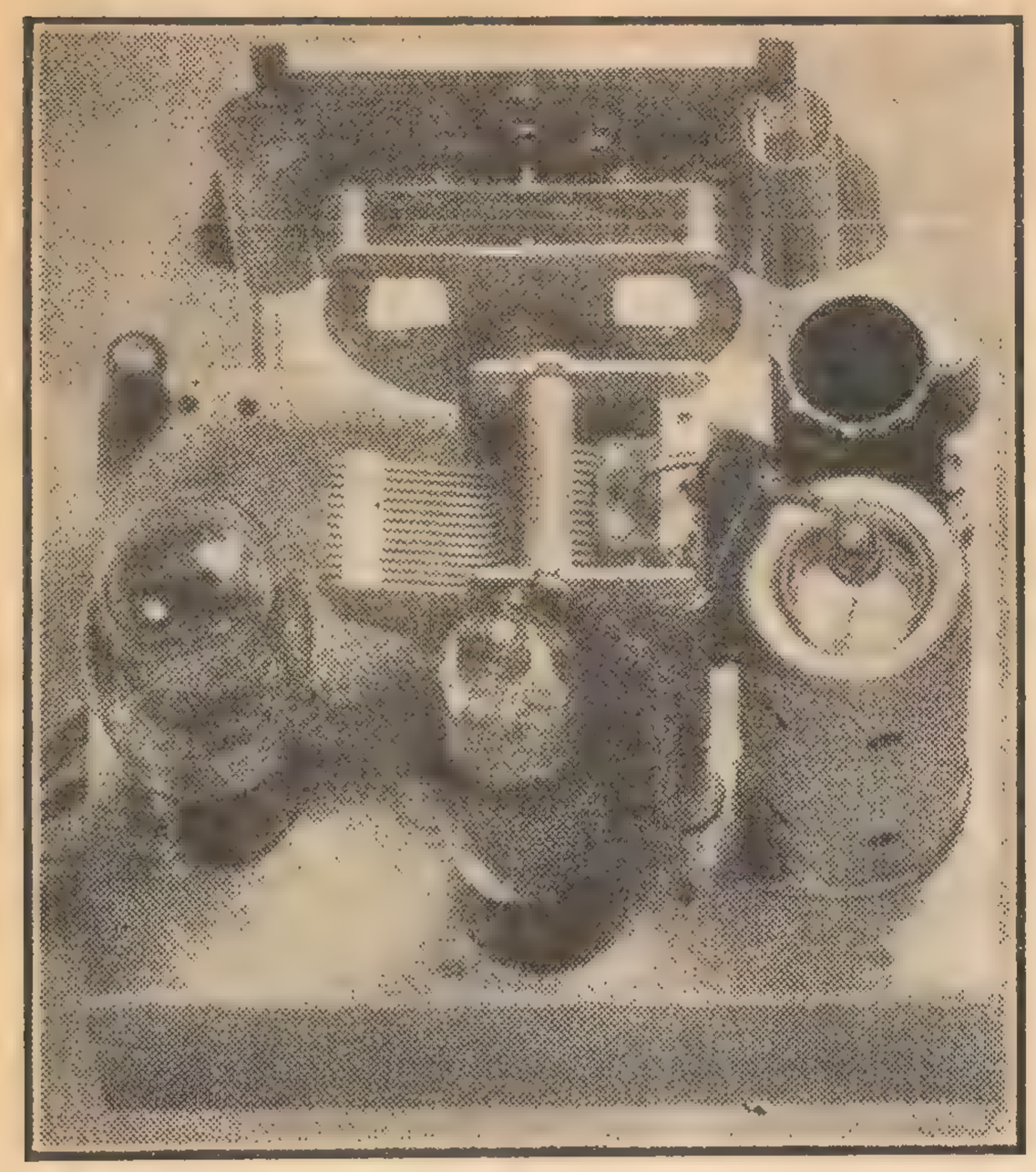

Figure 3. A rear view of the completed receiver. The tuning coil is on the right and to the front of the receiver. Behind it is the detector valve, which is shielded. Next in order comes the audio voltage amplifier and lastly the 1L5-G output valve. The aerial and earth terminals are to the front edge of the chassis, one in each corner. The detector grid condenser connects between the top of the gang and the grid cap, the grid leak being anchored to an insulated lug and then returned to A-plus.

There is no need for any R-F chokes in the screen circuit, the R-F voltages simply being fed through the reaction coil and then bypassed to earth through a heavy condenser. In the plate circuit, an R-F choke did not appear to be necessary, bypass condensers on the detector and output plates keeping the receiver quite stable as far as R-F feedback is concerned.

This whole detector circuit obviously requires the use of a pentode valve. Any attempt to use a triode would necessitate an altogether different circuit arrangement and a sacrifice in performance.

Owing to the high audio gain, more than usual precautions have to be taken to avoid audio feedback through the power supply. Although Mr. Ronlund did not provide it in his original circuit, our tests showed decoupling to be desirable in the interests of stability. The arrangement shown in the schematic circuit provides the necessary recoupling and, at the same time, avoids the necessity of having an extra lead to the B batteries for the detector plate and screen supply.

Plate load for the detector is a .05 megohm resistor. This value ensures sufficient gain without introducing excessive drop in the plate voltage.

AUDIO STAGE

Output is fed to an audio volume control in the grid circuit of the second audio amplifier stage. In the circuit, we have actually shown a two-way switch and terminals to allow a pickup to be fed into the receiver at this point. This is quite optional and need only be fitted if you are interested in gramo amplification.

If not required, the switch may be omitted altogether, the coupling condenser being taken direct to the upper terminal in the audio volume control. Gain at this point is ample to allow full output with any ordinary gramophone pickup.

The use of an audio gain control is advisable in the interests of selectivity. By making a practice of operating the detector at a point just below oscillation and turning up the audio volume control only as far as necessary for full volume, better performance is obtained than if the reaction control has also to serve as the volume control.

The second stage calls for little comment, as it is quite straightforward. The constants used are as suggested by the valve manufacturers.

For the position, obvious choice is again the 1K5-G, although the 1K6 or 1K7-G would serve equally well. Other sharp cut-off pentodes might serve, but some variation may be necessary in the circuit constants. If you are trying out other types, it will generally be satisfactory to leave the grid and plate circuit as they stand and to vary the screen series resistor for best results.

OUTPUT VALVE

Output from the 1K5-G goes to a 1L5-G output pentode. This is the octal-based equivalent of the 1D4. Other alternative types are the 1F4 or 1F5-G, or the English type PM22A.

Negative feedback is taken from the plate circuit of the output valve back to the plate circuit of the voltage amplifier. This serves the double purpose of improving the tontal quality and of holding the overall gain within limits imposed by the microphonic tendencies of the detector valve.

If microphony is not too obvious, the feedback may be rendered inoperative, especially on the short-wave bands, by shorting out the .02 megohm resistor. This will result in a marked increase in gain, but it may not be useable due to microphony or instabilitly.

BACK-BIAS SYSTEM

Bias for the output valve and for the audio voltage amplifier is obtained from a back-bias network. The advantages are well worth the slight extra complication in the circuit.

Main point is that the C battery, with its various connections is rendered unnecessary. It was desired to operate the output valve with a bias of 6.0 volts and the voltage amplifier with —1.5 volts. These voltages are not available from many 9.0 volt C batteries now sold, which have tappings only at —3.0 and —6.0 volts.

A further advantage is that the bias automatically adjusts itself to the B battery voltage, so that no additional adjustment is necessary to the bias as the B batteries run down.

A battery voltage required is 2.0 volts, the current drain being 0.48 amp. Actually the experimental receiver was not fussy about the A battery voltage and operated quite efficiently on a very run-down cell.

HIGH TENSION SUPPLY

For the high tension supply, a voltage of 135 is desirable, if high audio output is to be obtained. With this voltage, the high tension current drain is about 7.8 milliamps.

With 90 volts, performance is still quite good, although maximum power output, as distinct from sensitivity, suffers. However, there is sufficient power to work a loudspeaker at good volume; current drain was measured at 4.7 milliamps.

With 67.5 volts, current drain was 3.2 milliamps and 1.9 milliamps with a high tension voltage of 45 volts. Under these conditions a loudspeaker is not a very satisfactory proposition, owing to the very limited amount of power which the output valve is able to deliver. Nevertheless, the receiver will operate and will drive a number of pairs of earphones.

When used on the short-wave band

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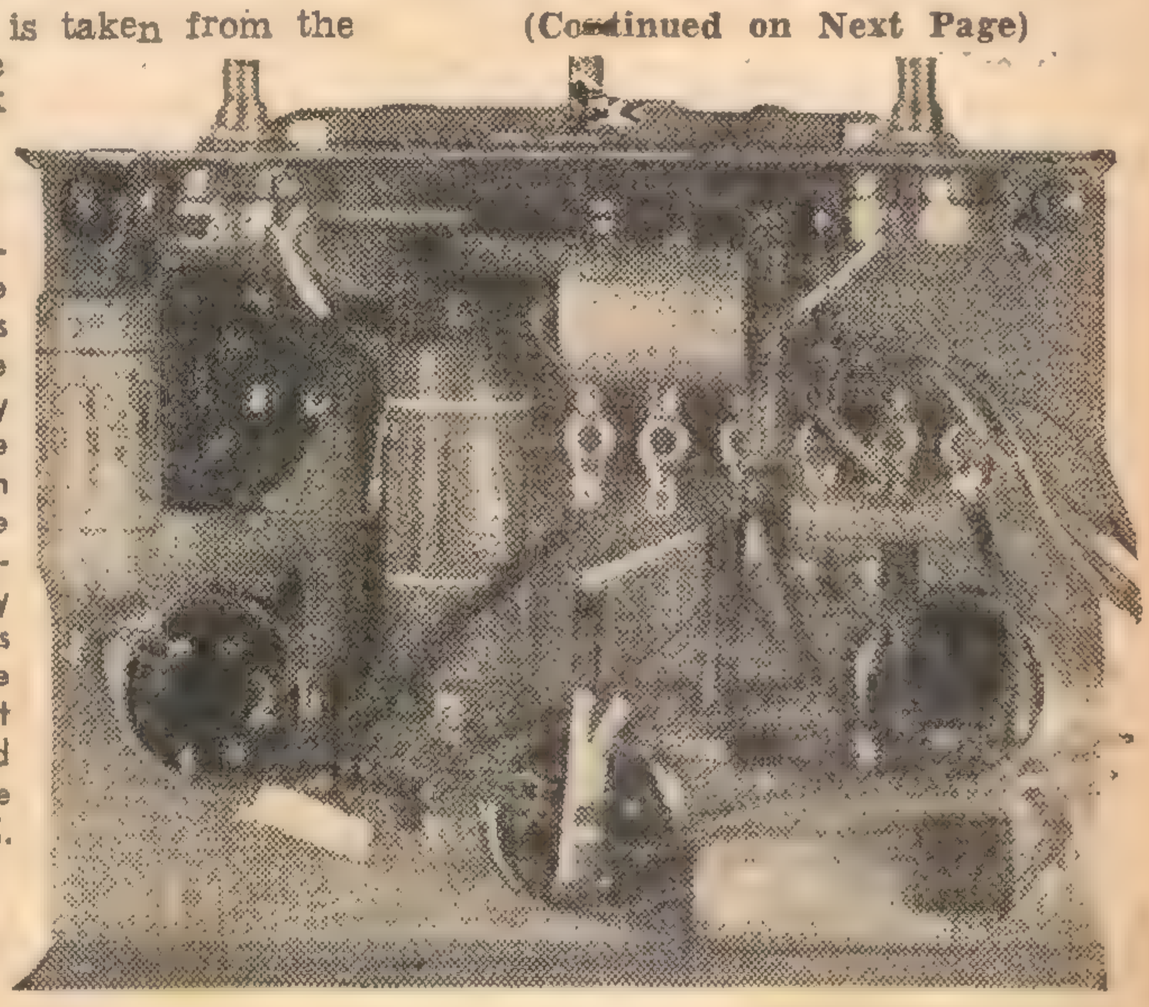


Figure 4. An underneath view of the chassis. Although it is quite a small affair, the parts are not unduly crowded together. Note the terminal strip which serves to anchor some of the wiring components. The battery and speaker wires simply go out one side of the chassis, but regula. plugs and sockets could be fitted if desired.

COMPLETE UNDERNEATH WIRING DIAGRAM

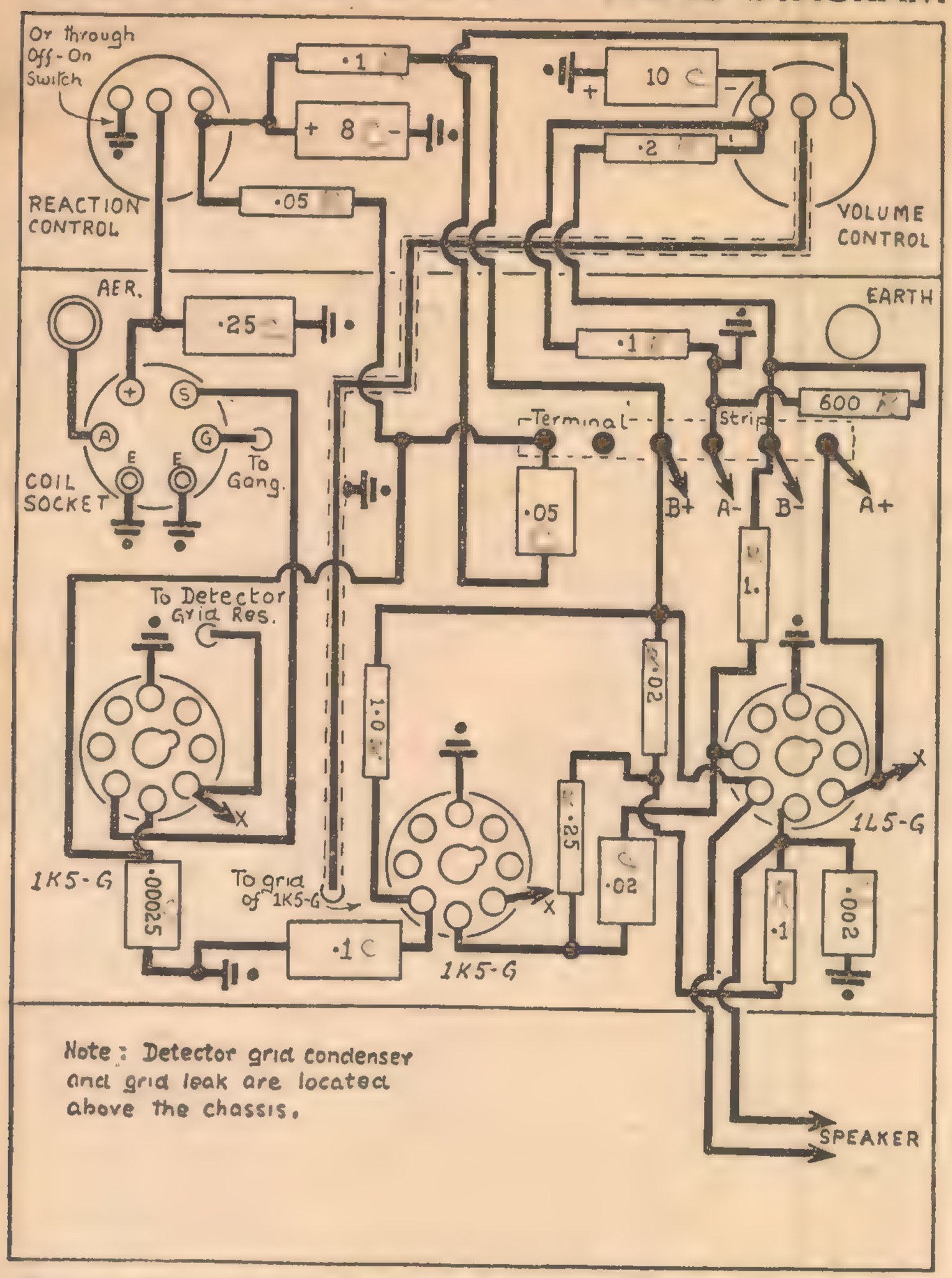


Figure 5. Here is the underneath wiring diagram for those who cannot quite follow the schematic circuit. Neither the pick-up nor the Off-On switches are shown. The Off-On switch may be incorporated in the chassis and wired as shown in the schematic circuit, or else arranged outside the chassis and wired to break the A-minus and B-minus leads.

with a high tension of much less than 90 volts, it may be necessary to add extra reaction turns and to reduce or eliminate, if possible, the decoupling resistor feeding the plate and screen circuit of the detector valve.

In other respects the circuit would remain unaltered. The back-bias resistor is of such a value that it gives about the right amount of bias for the two amplifier valves under all conditions of high tension voltage.

ELECTROLYTIC CONDENSERS

The only two items in the circuit with which a battery set enthusiast may not be entirely familiar are the 8 mfd and 10 mfd condensers, which are of the electrolytic variety. These are not expensive items and are to be preferred for the purpose to paper condensers, which have a much lower capacity for the same bulk.

When connecting the electrolytic condensers into circuit, make sure that you identify the postive and negative conections and wire them up as indicated in the schematic circuit diagram.

For the construction of a receiver of this nature, we prefer the modern idea of a metal chassis, with all the wiring underneath. The metal chassis makes a convenient earth return and has a valuable shielding effect, which helps in the matter of stability. A further advantage is that proper use of a metal chassis minimises hand-capacity effects. In our experimental receiver, there was absolutely no trouble on this score.

The chassis, which is used and which is shown in the photographs, was just a small one which happened to suit our purpose. It is not a stock chassis, but could be duplicated, without much trouble, by any enthusiast handy with tools. A scrap of galvanised iron or tinplate is all that is necessary, with a small tin of enamel to add finish, if desired.

RESISTOR COLOR CODE

VALUE	BODY	END	DOT
2 meg.	Red	Black	Green
1 meg.	Brown	Black	Green
25 meg.	Red	Green	Yellow
2 meg.	Red	Black	Yellow
1 meg.	Brown	Black	Yellow
.05 meg.	Green	Black	Orange
.02 meg.	Red	Black	Orange

WATCH INSULATION

On the other hand, a chassis may be made up from masonite and wooden ends, with a masonite front panel. However, we would suggest that a sheet of metal be fastened to the rear of the front panel, and connected to the earth terminal. This will help to overcome hand capacity effects.

Those not used to working with metal chassis or panels will need to watch the matter of insulation, making sure that no component, control or terminal makes electrical contact with the earthed metal plate unless such a contact is indicated in the circuit.

Note that the shafts of modern carbon potentiometers are almost invariably insulated for the moving contact so that the shafts can and should be earthed. The same remark does not always apply to switches. The tuning condensers should be connected into circuit in such a way that the rotor plates are earthed, and also the framework of the dial mechanism.

HAND CAPACITY EFFECTS

Hand capacity effects occur mainly, either because there is no shielding around the tuning coil or because there are masses of unearthed metal in proximity to it. In the experimental receiver, the tuning coil was fairly effectively enclosed in the front by the earthed dial mechanism, on the side by the earthed frame of the tuning condensers and at the rear by the earthed valve shield over the detector.

The operator's hands do not normally approach the side of the coil which is not so shielded. Note that it is not wise to carry this to extremes and there should be a reasonable amount of clearance between the circumference of the coil and components adjacent to it.

The tuning condenser should preferably be one of the modern types, having a maximum capacitance of about .0004 mfd. However, this is not essential and an old type will serve quite well if it is in good mechanical condition. Make sure that the plates are clean and that the bearings are tight enough to eliminate any sloppiness, without however being jumpy in action.

EARTHING OF ROTORS

Some flexible connection between the rotor plates and the frame of the condenser is desirable, as the electrical connection through the bearings is not always a good one.

A smooth vernier dial is a necessity. It can be of the front-of-panel or back-of-panel type, as desired. The dimensions of the tuning gang and dial will determine to a certain extent the chassis dimensions and layout.

The oscillator grid condenser mounts between the stator terminal of the tuning gang and the grid cap of the detector valve. The grid return resistor should also be above the chassis, with a lead passing down at the positive filament terminal. Connection between the tuning gang and the coil may be made by a lead under the chassis.

We anticipated that most of the enthusiasts, who build up this receiver, will want to try it out on short-waves, so that the experimental model was arranged for plug-in coils. This is a much simpler and cheaper arrangement than coil switching in a small receiver of this nature.

For the rest, the construction should not present any great difficulty, for the layout of the parts is clear from the drawings and photographs. If you cannot follow a schematic circuit, the underneath wiring diagram will help you out in the matter of the wiring.

SPEAKER, BATTERY PLUGS

Because it was purely an experimental receiver, we did not bother to include the Off-On switch in the original receiver. This would be a necesssary feature in any receiver built up for regular home use and it may be included and wired up as shown in the schematic circuit diagram. Alternatively, it may be fitted to the side of the cabinet and arranged to break both the A-minus and the B-minus leads as they come up from the batteries.

Because of lack of space, the experimental receiver was not fitted with plugs for the loudspeaker and batteries. If you have, say, a four and a five pin plug on hand, they may be used respectively for the speaker and battery connections. It is very handy to be able to pull out a couple of plugs and lift the chassis out completely without having a lot of leads tailing to it.

A further advantage is that the batteries can be disconnected in an instant, when experimenting with the circuit. One should be wary of poking around the interior of a battery receiver with the batteries connected.

Unfortunately, suitable plugs are not too plentiful at the moment and it may be necessary to use permanent leads to the speaker and batteries, in any case.

However, you arrange the loudspeaker connections, make sure that the plate circuit of the output valve is kept well away from the rest of the wiring, particularly that to do with the detector. With the high audio gain in this receiver, it does not require very much feedback to cause instability. If the output plate lead has to be led around the chassis for any distance, it is as well to shield it.

THE OFF-ON SWITCH

In our experimental receiver, the speaker leads were connected to the plate and screen of the output valve and taken straight out the side of the chassis. For the sake of rigidity, some of the other leads were anchored to a terminal strip, as shown in the underneath wiring diagram. Note that the grid lead of the 1K5-G audio amplifier should be shielded.

When you come to wire the volume and reaction controls, be careful to arrange the leads exactly as we have shown them in the underneath wiring diagram. Wired in this way, rotation of the controls in the clockwise direction will result in an increase in output. Wired the other way round, the controls would operate back-to-front and would be very critical to adjust. Reason for this is that carbon controls have what is termed a "tapered" element, the resistance changing more gradually when the arm is set towards counter-clockwise position.

The final matter to be discussed in detail is that of the tuning coils. Although we did not try it out, the commercial "Reinartz" aerial coil with re-

(Continued on Next Page)

COIL WINDING DATA

BAND.	PRIMARY.	SECONDARY.	REACTION.
Broadcast Band.	15 t. 32 g. enam. spaced ⅛in. from earthed end of secondary.	110 t. of 32 g. enam., close wound.	40 t. 40 g. enam. spaced ⅛in. from grid end of secondary.
70 to 220 metres. 4.3 to 1.3 mc/s.	11 t. 32 g. enam. spaced ⅛in. from earthed end of secondary.	38 t. of 24 g. enam., close wound.	20 t. 32 g. enam. spaced ⅛in. from grid end of secondary.
30 to 90 metres. 10 to 3.3 mc/s.	5 t. 32 g. enam. spaced ⅛in. from earthed end of secondary.	14 t. 24 g. enam. spaced slightly to occupy ½in.	12 t. 32 g. enam. spaced ⅛in. from grid end of secondary.
10 to 33 metres. 30 to 9 mc/s.	3 t. 24 g. enam. spaced ⅛in. from earthed end of secondary.	5 t. 24 g. enam. spaced to occupy ½in.	8 t. 32 g. enam spaced ⅛in. from earthed end of secondary

action, of the type used in some of our other small receivers would doubtless be quite OK with this set. Only point of note would be that the end of the reaction winding intended to go to plate would be taken to screen. The end normally going to the reaction condenser would go to the moving arm of the control potentiometer

The usual commercial Reinartz coils are available for the broadcast band only and are not intended for use as plug-in coils. Those who want to cover more than one band will normally have to wind up a complete set of coils for themselves. The following information should be helpful:—

For plug-in coils, the most commonly used formers are the Marquis ribbed formers having an effective diameter of 1¼in. In the experimental receiver we used the six-pin variety, which provided two pins for each of the three windings. By using a common pin for the earth connection to the aerial and secondary windings, a five-pin former would serve the purpose.

WIRING THE SOCKETS

A glance at the underneath wiring diagram will show how we arranged the connections to the pins. The diagram on this page shows the connections to the various windings. There is no particular need to use the same coil socket wiring as we did and you can rearrange the wiring if you are able to achieve shorter connections by so doing. The vital consideration is to see that, when the coil is plugged in the coil socket, the respective windings are connected correctly into the circuit.

All windings must be wound on in the same direction. The number of turns, gauge of wire and spacing are shown in the table above. Winding wires are all very scarce at the moment, but it is as well to use wire as near as possible to the gauge recommended.

Gauge of wire on all primary and reaction windings and on the secondaries of the two smallest short-wave coils is not particularly critical, and can be varied without much effect. Use of winding wire having greater or lesser overall diameter on the secondaries of the broadcast and 70-220 metre coil will result in a longer or shorter winding. This may affect the inductance slightly and necessitate the removal or addition of a few turns to cover the specified bands.

It should be emphasised that the coil specifications given in the table are only what we found to suit a particular receiver and a particular set of reception conditions. While coils wound to these specifications will almost certainly work well, the patient experimenter can usually achieve some improvement by varying the number of turns and the spacing to suit his particular receiver and reception conditions. These remarks apply particularly to the reaction and primary windings.

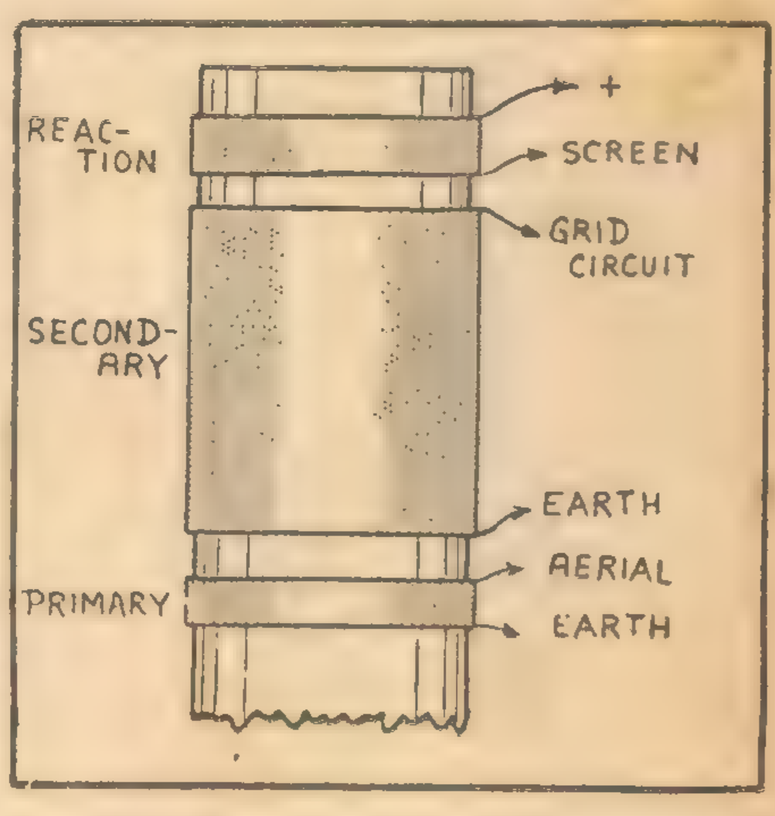


Figure 6. All coils should be wound in the same direction to the specifications given above. The connections to the various windings are as shown in this diagram.

Selectivity is dependent to a certain extent on the number of turns and the spacing of the primary winding. Fewer turns and/or increased spacing will improve selectivity at the cost of output. A loose aerial coupling will also help the reaction circuit to function smoothly and to eliminate dead spots, particularly on the highest frequency band.

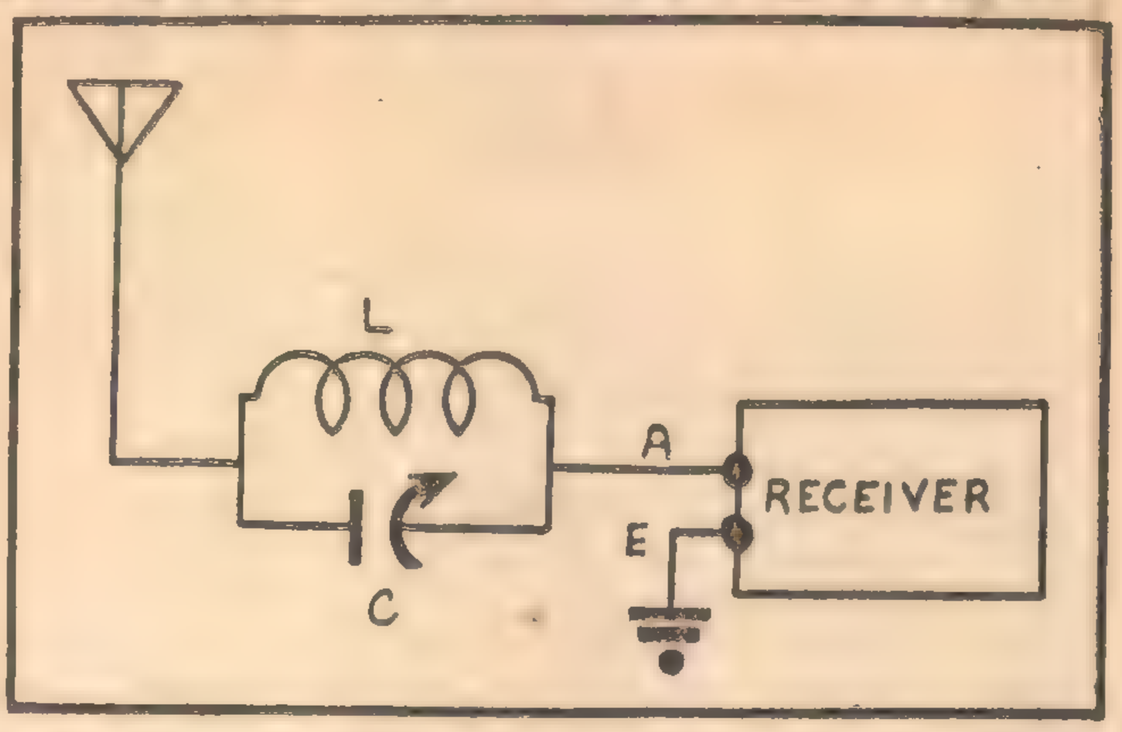
If you are situated a long way from the nearest broadcast station, try eliminating the aerial winding on the broadcast coil altogether, and tapping the aerial in about 15 or 20 turns from the earthed end.

For general hints in regard to coils, see page 39 of the July, '42, issue, or page 43 of the January, 1943, issue.

We trust that this circuit will make happy the many country readers who have been asking for a circuit of a simple all-wave battery receiver.

HOW TO MAKE AND INSTAL A WAVETRAP

Listeners living in the immediate vicinity of a broadcasting station often have their patience tried by the way the powerful signal plays havoc with their radio reception. The signal may blanket or modulate the signals from other stations or it may come in at odd and unexpected points on the dial. In some cases the complaint may simply be bad distortion on the station in question.



THESE effects can either be due to some limitation in the design of the receiver or to external conditions. Whatever the cause, however, a cure can often be effected by installing a wavetrap in the aerial circuit.

Wavetraps can be arranged in a variety of ways, but the simplest and possibly the most effective is as shown in the accompanying sketch. The wavetrap takes the form of a parallel tuned circuit, connected in series with the aerial lead-in.

The idea is to resonate the circuit at the frequency of the offending station and the wavetrap then functions as a sharply-tuned rejector circuit, which discriminates against the strong carrier but allows others to pass more or less unaffected.

In order for the wavetrap to function efficiently, it is necessary to see that the major portion of the signal fed to the receiver actually arrives by way of the aerial circuit. In the main, this means that a reasonably efficient aerial must be used and that the chassis of the receiver is earthed to an effective earth connection. It is often as well, in such cases, to avoid the use of service pipes for this purpose. In the case of mains receivers, a properly-earthed line filter is often an asset, preventing the entry of radio frequency voltages by way of the mains.

CONDENSER AND COIL

The variable tuning condenser "C" need not be an expensive type, as long as it is in good condition. It should preferably have a maximum capacitance of about .0004 or .0005 mfd. It has to be connected across a tuning coil "L," the two being coupled, as shown, in series with the aerial lead-in, and as close as practicable to the aerial terminal of the receiver.

The coil "L" must be capable of being resonated at any desired point in the broadcast band by the condenser "C." For the purpose, the grid (or secondary) winding of any ordinary broadcast aerial or R-F coil may be used. Other windings may be left in position if you are just trying out different coils, but they should preferably be stripped off.

Alternatively, a coil may be wound up on a piece of 1½in. diameter former. Wind on 110 turns of about 32 gauge enamel wire. If you come across any more suitable specifications for the secondary of a coil to cover the broadcast band, they will serve just as well.

There is seldom any need to shield the wavetrap circuit, but some may care to try shielding it in a metal box which can then be earthed. However, he careful to insulate all connections to the coil and condenser from the metal case.

Having installed the wavetrap as shown in the diagram, tune the receiver carefully to the strong station and vary the setting of the wavetrap tuning until the signal is at its weakest. With a receiver equipped with AVC, this point will not be easy to pick, but keep trying until you find a spot at which the receiver tuning seems least broad.

If the set has a tuning indicator, tune the wavetrap until the indicator is seen to dip, indicating that the strength of the incoming signal has been reduced.

If second-spotting, cross-modulation, or distortion has been the trouble, the correct setting of the wavetrap is indicated by a partial or complete disappearance of the trouble.

Possibly a wavetrap may not solve your difficulty, but it is an extremely simple device and well worth a try-out.

WORK OUT YOUR OWN MATHS PROBLEMS

(Continued from Page 27)

EFFECTIVE VALUE OF A-C

Since the voltage (or current) in an a.c. system is rapidly changing direction and consequently does not maintain a constant value, it can be readily understood that an alternating current of 1 ampere maximum could not be expected to produce as much heat as 1 ampere of direct current.

So an alternating current is said to be equal in value to a direct current of so many amperes, when it produces the same heating effect. This is known as the effective value, and is neither the instantaneous nor maximum value, but an entirely different one.

This effective value is arrived at by taking the instantaneous value of current over a cycle of alternating current, squaring these values, taking the average of the result obtained and then extracting the square root of this average.

This is also known as the root-mean square or r.m.s. value. The value of the current for a sine wave secured in this manner is 0.707 times the maximum value. Thus:—

E eff. = 0.707 E max.
I eff. = 0.707 I max.

It should be mentioned at this point that, nearly all A.C. meters, however calibrated, give a reading which is proportional to the effective value of an alternating current.

AVERAGE VALUE

Another value encountered is the average value This is simply computed by taking the average of all instantaneous values between two consecutive zero points on a curve. For a sine wave this value works out to be the 0.636 of the maximum or peak value.

The maximum or peak value of an alternating current or voltage is the greatest value that it attains during any one alternation. Reference to figure 3 will clearly show that this latter is actually only an instantaneous value. That is, the maximum current only flows for an instant during any single alternation.

Since the three terms peak, effective (r.m.s.) and average are frequently being encountered, the following relationship between the three factors should be committed to memory.

$$E_{max.} = E_{eff.} \times 1.414 = E_{ave.} \times 1.57,$$

$$E_{eff.} = E_{max.} \times 0.707 = E_{ave.} \times 1.11,$$

$$E_{ave.} = E_{max.} \times 0.636 = E_{eff.} \times 0.9.$$

If current is being considered instead of voltage, then I should be substituted for E in the above formulae.

(1) Find the effective value of a voltage whose max. value is 311 volts.

$$E_{eff.} = E_{max.} \times 0.707,$$
$$= 311 \times 0.707,$$
$$= 220 \text{ volts. approx.}$$

(2) Find the max. value of an alternating current whose effective value is 328 amps.

$$I_{max.} = I_{eff.} \times 1.414.$$
$$= 28 \times 1.414,$$
$$= 39.59 \text{ amps.}$$

IN CONCLUSION

A great deal of new ground has been covered in this article and so if you are not too sure of any point, then we suggest you read over that particular section of the text once more.

As you will realise. it has been necessary to deal with some sections quite briefly, but as we meet these in later articles. much fuller explanations will then be given.

In the next issue we will follow on from here and deal with series and parallel condenser and inductor circuits, as well as the meaning of reactance and impedance.

THE P.E. CELL AND ITS APPLICATIONS

The photoelectric (PE) cell, or phototube as it is often called, is used in a wide variety of applications. It makes possible the sound in a modern talkie theatre, it is used in relay circuits to open and close doors and to switch lights off and on, it is used to measure light intensity and color values, to grade and sort materials and objects, and performs a host of other tasks.

Mr. L. B. GRAHAM
Principal of the A.R. College.

THERE is quite a number of different types of photoelectric cells, each of which has advantages for certain types of work, either due to its particular sensitivity or its color range. The fundamental principles, however, are the same in all types.

Most cells consist of two elements enclosed in a glass tube, from which the air has been removed. The two elements are respectively a plate and cathode; the former is a thin metal rod usually in the centre of the tube, and the latter a flat or semi-circular plate coated with a special light-active substance.

LIGHT AND EMISSION

In an ordinary radio tube current is able to flow in the plate circuit because electrons are emitted from a heated filament or cathode. These electrons are attracted to the plate by its positive charge.

In the case of a PE cell, plate current flows in a similar fashion, but there is a difference in the method by which the electron emission is obtained. The radio tube relies on the heated cathode to emit the electrons; in the PE cell or light value, as it is often called, electrons are emitted owing to the action of light rays on the light-active cathode material.

Having the cathode of the light cell exposed to light it is, in effect, equivalent to having the cathode of a radio tube heated.

However, the light cell does not depend on a grid to control the amount of current flowing in its plate circuit as does a radio tube, in which the cathode temperature and emission remains constant. Instead, the plate current in a PE cell depends on the amount of light falling on the cathode.

Within certain limits, the emission of this cathode material is in proportion to the strength of the light falling upon it.

The sensitivity of a phototube is defined from the amount of plate current in microamperes resulting from light rays of a definite power striking the cathode material. This includes both visible and invisible radiations of light. Certain cells are more sensitive to infra-red or ultra-violet radiations than others.

GASEOUS TUBES

By introducing a small amount of inert gas into the cell, its sensitivity is increased, or, in other words, the gas increases the amount of plate current passed for a given illumination of the cathode.

The gas type cell is used frequently for sound reproduction because of its greater sensitivity. The high vacuum type is more suitable for the operation of relays, for it is better able to stand overloads in the way of excessive plate voltage, and its sensitivity is more constant throughout its life.

If an excessive plate voltage is applied to a gas-filled tube, the gas ionises. This is indicated by a faint blue glow in the tube, and, should it occur, the plate voltage should be disconnected immediately, otherwise the tube will be damaged.

The effect of having a small amount of inert gas in the cell is as follows:—Electrons moving from cathode to plate collide with gas atoms and in doing so, disrupt the atoms and liberate new electrons, leaving a positive ion. The new electrons thus produced are drawn to the plate and the positive ion is attracted to the cathode.

As a result of this action, the total current through the cell is increased considerably.

The above stated action of the gas causes a small degree of lag in current changes, resulting from a varying light source and the effect of very rapid changes of light values tends to be smoothed out. In high fidelity sound reproduction, this tends to reduce the output at high frequencies, but, with tubes designed for this type of work, the loss is not very great, and good fidelity may be obtained in practice.

A TYPICAL CIRCUIT

A circuit using a phototube and suitable for sound reproduction is shown in Fig. 1. When the light falls on the cathode of the phototube, current flows from the B-plus through the 2-megohm resistor. This current produces a voltage drop across the resistor and, as it varies with changing light intensity, voltage changes occur, which are applied to the grid of the amplifying tube through the .01 mfd. coupling condenser.

The amount of light falling on the cathode of the phototube in a sound-on-film system is very small, as the light from the exciter lamp in the sound head must pass through the film and through an extremely narrow slot before being focused on the tube's cathode.

Some special sound-on-film systems use two tracks and a special phototube with the two cathodes and two plates which can be arranged to give push-pull action.

The current which flows through the phototube is very small and very high resistances are required in the external circuit in order that a reasonable voltage may be developed for application to the first amplifying tube.

The input impedance of the first amplifying tube must be kept high to allow this voltage to be applied successfully to the tube's grid. This involves wise choice of the grid return resistor, and also of a tube which will not draw a noticeable amount of grid current.

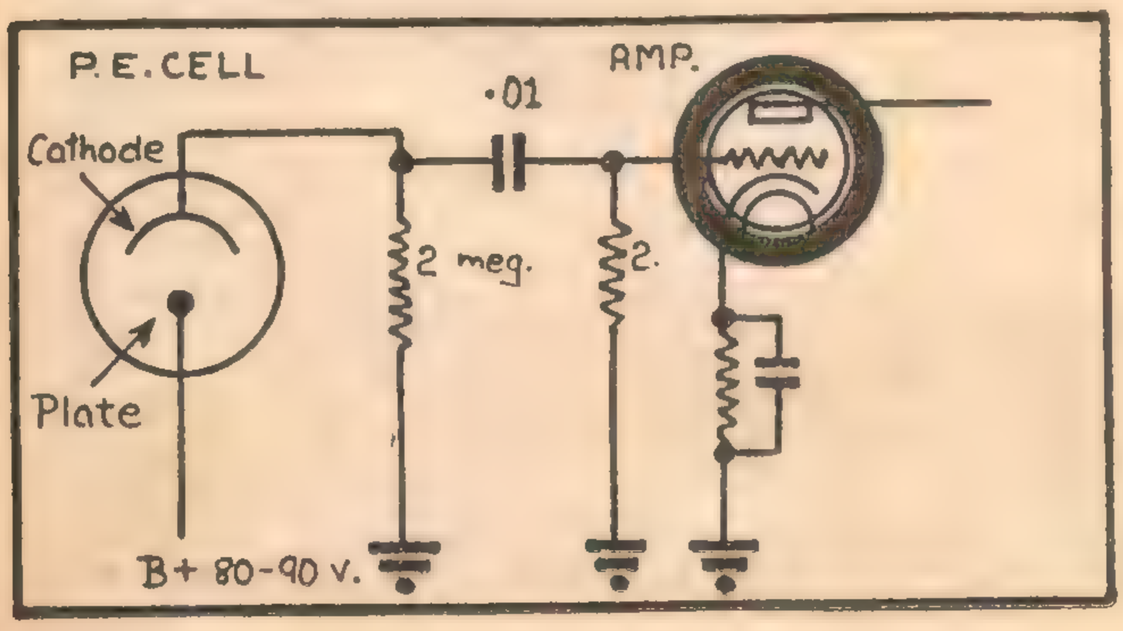


Figure 1. One method of coupling a PE cell to an amplifier for sound reproduction. The coupling condenser is often made considerably smaller than .01 mfd. in order to reduce the output at lower frequencies and to obtain more crispness in reproduction.

SPECIAL PRECAUTIONS

It is necessary with some types of tubes to use a heater voltage lower than normal, and also to keep the plate current as low as possible. The heating of the tube is thus reduced and grid current troubles are partially, if not completely, eliminated.

Owing to the high impedance of the input circuit and the large degree of amplification necessary, the shielding of the parts and circuits around the phototube must be very good and supply voltage should be very smooth; in fact, in many cases battery supply is preferable.

Most other uses of the phototube associate it with relays; for the operation of such, special gaseous amplifier tubes have been designed which give large changes in plate current for very small change in voltage on the grid.

Fig. 2 shows a simple d-c operated relay circuit using a gas triode tube. When this circuit is adjusted correctly, interruption of the light beam will close the relay and complete the controlled circuit.

ACTION OF CIRCUIT

The action of the circuit shown in Fig. 2 is as follows: A light beam falling on the cell allows current to flow from B-plus through R1 and the cell to C-minus, reducing the voltage at the grid end of this resistor. This gives the tube a certain amount of negative grid bias, which keeps its plate current low, and, owing to the arrangement of the contacts on the relay, the controlled circuit remains open.

When the light is interrupted or weakens beyond a certain point, the current flowing in the cell circuit drops to such an extent that the tube receives practically no bias and the plate current rises, causing a greater magnetic pull by the relay magnet; the contacts are pulled together, thus closing the controlled circuit.

The potentiometer R2 controls the operating point of the circuit.

The relay itself works in the following manner: The plate current of the amplifying tube flows through the relay coil and magnetises the iron core, which exerts an attraction on an iron flap held away by the tension of a spring.

When the current through the coil is increased sufficiently, it draws the flap to the pole piece of the coil's core, and brings two contacts together—one fixed on the coil housing and one on the movable flap.

SPRING OPENS CONTACTS

Should the plate current fall again, the magnetic attraction decreases and the spring pulls the contacts apart. Circuits such as this work small relays which are, in turn, arranged to operate larger relays to control electric motors or control the switching on of street lights when daylight fails.

In industry, photo-electric cells are used to save labor and as protective devices. For example, the breaking of wire or thread passing through a machine may allow light to pass through a small aperture into the cell; this, in turn, may operate a relay to stop the machine, thus eliminating the necessity for someone to watch the machine.

Certain objects may be graded according to size by the use of a photocell and relay circuit One way in which this could be arranged would be to have the objects pass through a light beam, thus obscuring a certain amount of light from a phototube If the object obscures too much or too little light, the phototube may either cause some mechanical apparatus to turn these to one side or, at least, work an indicator light or bell so that the operator is informed.

COLOR MATCHING

Variations in the color of materials being manufactured may also be detected by the use of photo-electric cells.

As mentioned earlier in this article, some cells are more sensitive to certain colors. This being the case, one is selected which is sensitive to the particular color which is to serve as a standard for production. All other light radiations are kept away from the tube by the use of a filter.

The filter usually consists of a piece of glass colored the same as the material and light to be passed.

The cell is carefully adjusted on the light radiations of this color and consequently any variations of the color in manufacture will either increase or reduce the intensity of this particular color radiation and cause the cell's current to change, thereby operating some kind of indicator or relay.

When working with photo-electric cells, care should be taken to avoid exposing the cathode to powerful light as the light sensitive substance will temporarily lose its sensitivity. The cell may, however, recuperate if kept in the dark for some time.

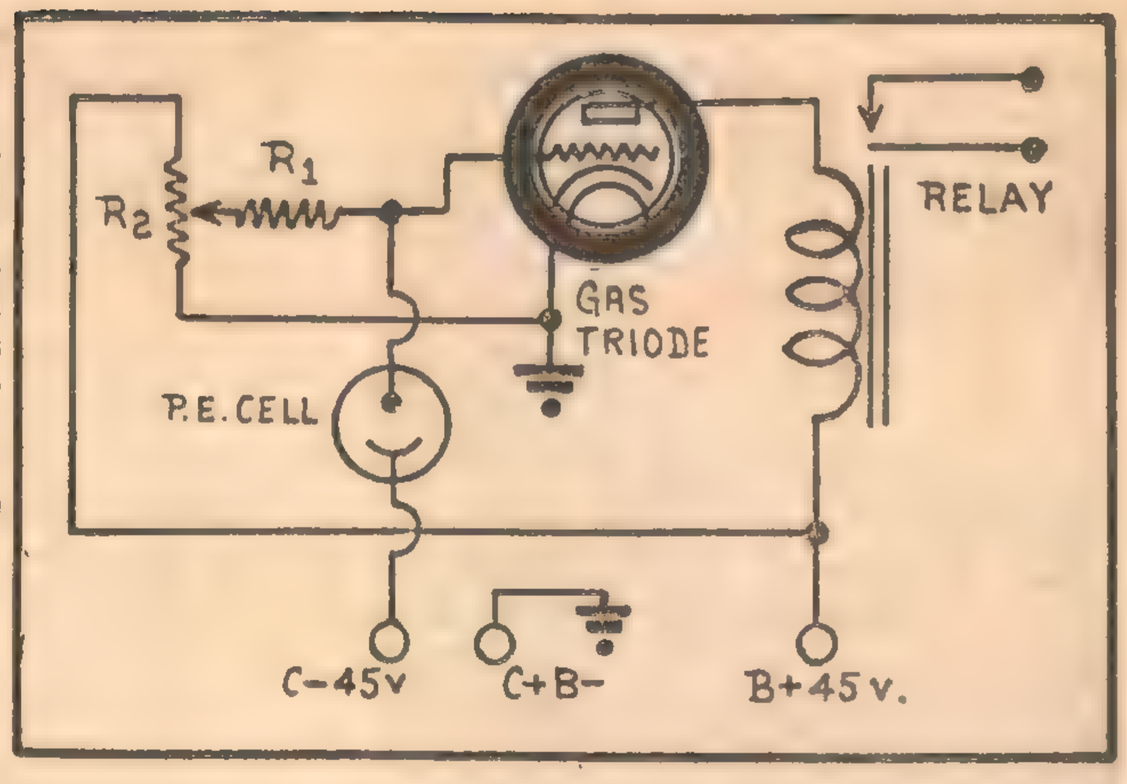


Figure 2. A typical relay circuit using a phototube and gas triode amplifier valve. The circuit may be varied to obtain different operational characteristics. Although gaseous amplifier valves are particularly suitable for some applications, a relay circuit may readily be arranged using ordinary amplifier tubes.

BROADCAST BAND DX

by Roy Hallett

Reports from many parts of the Commonwealth and from New Zealand, received during the last few weeks, mention reception of some good signals from a number of overseas countries. Unfortunately, during our summer months, static often spoils the enjoyment of a programme from a station which would otherwise be heard at good entertainment level.

DESPITE this, few, if any, DX'ers let static stop them chasing new stations and copying reports on station's transmissions.

Verifications from overseas stations are few and far between these days, but a number of our readers are still receiving cards and letters from the American countries and from New Zealand. Quite a few of our new readers are having lots of fun with the fine cards and interesting letters sent out by many of our own Australian National and commercial stations.

CONDITIONS WILL CHANGE

During the month of March, some big changes may be expected in broadcast band DX conditions. At this time each year, the European stations we have been hearing during the past few months around runrise usually fade out, to return again just before summer.

The Americans, heard around midnight during summer, also retire for the winter about this time, and DX'ers are advised to keep a sharp lookout now for American stations from just after sunset till late at night, particularly in the 1500 to 1600kc. region of the dial. Most Americans that may be heard on the main section of the dial are jammed by Australians on the same channels.

In this issue, we present a longer list than usual, of American stations, DX'ers may like to try for during the next few weeks before they fade out around midnight. The usual batch of better-known stations, comparatively easy to log, together with stations not so frequently heard in this country, is also given.

Our request for information concerning the reception of the various services stations (police, ambulance, &c.), in last month's "Radio and Hobbies," yielded some very interetsing results.

Mr. Roy Taylor, of Mosman, NSW, tells us that after sending five or six reports to the Sydney Police Station, VKG, he received a courteous letter from them, telling him that, as the transmissions were of a private nature, they were unable to verify his reception of this transmitter. Our friend has also received an acknowledgment of his report to VKK, the Sydney Electricity Department's station, in the form of a letter, thanking him for his interest in the station's transmission.

Mr. Taylor quotes the approximate frequencies on which he hears some of these transmitters.

VKG, 1710kc. 175m. Sydney Police.
VKC, 1640kc. 183m. Melbourne Police.
VKL, 1520kc. 197m. Used to transmit time signals.
VKK, 2130kc. 140m. Electricity Department, Sydney.
VKR, 2170kc. 138m. Brisbane Police.
VJA3, 1670kc. 180m. Sydney Ambulance Service.
VKB, 2150kc. 139m. Maitland Trucks.
VLN6, 2910kc. 103m. Sydney Commercial Phone.

Many of our readers may not possess radios designed to operate on this region of the dial, but for those of you able to hear these stations, you may be interested to know just what transmitter it is you are listening to.

You will not be able to find much of interest in messages broadcast over these stations, as the essentials are usually given in code, known only to those concerned. Frequencies and metres quoted are only approximate.

ILLEGAL TRANSMITTER

Quite a deal of excitement was created in New Zealand by the appearance and eventual capture of an illegal transmitting station.

Several listeners in NZ had heard this mystery station, operating on various channels, playing gramophone records, announcing their titles, but giving no call-sign or details of location whatsoever. With the assistance of several NZ DX'ers, portable direction finding apparatus, &c., the NZ P and T radio inspector has succeeded in finding the location of this station.

It was discovered that 20-year-old Maurice Emmett Maloney was operating a low-powered (1-watt) transmitter from his home at Makarewa, South Island. At his trial on December 8, 1942, at the Magistrate's Court, Invercargill, the defendant pleaded "Guilty" to the charges made against him, and his equipment, including gramophone records and two transmitters, valued at approximately £50, was confiscated, and a fine of £3 was imposed.

STATION VERIS

Quite a number of our readers, particularly newcomers to this grand hobby of ours, have received some fine cards during the last few weeks from many Australian and some New Zealand stations. Not very much from overseas unfortunately, although the writer has been fortunate in receiving three QSL's from America.

XEAW, 1570kc., Reynosa, Mexico. This powerful Mexican, transmitting from Reynosa, and broadcasting from their studios at 912 Commerce-street, Dallas, Texas, USA, sent a very fine letter, verifying my reception of their transmission. Many of our readers have already received this station's verification, and will agree with me that their letter is well worth waiting for. XEAW is now also heard on 1050kc.

KHJ, 930kc., Los Angeles, California, USA. This station verified by letter, and a pamphlet containing a brief history of the Mutual Broadcasting System, of which KHJ is a member.

The Don Lee Broadcasting System, affiliated with MBS. control KHJ, as well as a network of other stations in Western US, America.

WBAP, 820kc., Fort Worth, Texas, USA. A novel buff card was received from this station, with a clever drawing of a cowboy's outfit in the left bottom corner. Call signs of WBAP and KGKO are printed on the card, encircled by the cowboy's lassoo. Apparently these two Fort Worth stations work in conjunction with one another, as do KPO and KGO, San Francisco. WBAP shares its channel with WFAA, Dallas; these two carry out a continuous service on this channel. A very nice letter indeed accompanied their card.

READERS' REPORTS

We would like to thank the following readers who have kindly sent along reports during the past few weeks, and thus helped in the compiling of our notes for this page.

D. Berndt, Wootha, Qld.; A. S. Condon, Laura, SA; K. B. Gaden, Quilpie, Qld.; R. Taylor, Mosman, NSW; L. Smith, Glenn Aplin, Qld.; L. Gliddon, Upwey, Vic.; R. J. Brock, Maroubra, NSW.

LISTEN FOR THESE STATIONS

Here is a list of some American broadcast band stations, likely to be heard in this country during the next few weeks. This list is by no means complete. Some of these stations are seldom heard here, so they will be something for our more experienced readers to chase. Try for these around midnight and 1.0 am unless otherwise stated. * Indicates easier logged staticns.

CBK, 540kc., Watrous, Sask., Canada.
KSFO, 560kc., San Francisco, Calif., USA.
KLZ, 560kc., Danver, Colorado, USA.
KMTR, 570kc., Los Angeles, Cal., USA.
KVI, 570kc., Tecoma, Wash., USA.
KGKO, 570kc., Fort Worth, Texas, USA.
KUTA, 570kc., Salt Lake City, Utah, USA.
KMJ, 580kc., Fresno, Calif., USA.
KHQ, 590kc., Spokane, Wash., USA.
KGMB, 590kc., Honolulu, Hawaii. Best around 3.0 and 3.30 am.
KFSD, 600kc., San Diego, Calif., USA.
KFRC, 610kc., San Francisco, USA.
KGW, 620kc., Fortland, Oregan, USA.
KOH, 630kc., Reno, Nevada, USA.
KFI, 640kc., Los Angeles, USA.
LS4, 674kc., Buenos Aires, Argentina, Sth. A.
KPO, 680kc., San Francisco, Calif., USA.
WLW, 700kc., Cincinatti, Ohio, USA.
KIRO, 710kc., Seattle, Wash., USA.*
KMPC, 710kc., Beverly Hills, Calif., USA. Sometimes heard under KIRO.
KQW, 740kc., San Jose, Calif., USA.
CBL, 740kc., Toronto, Ont., Canada.
KXL, 750kc., Portland, Oregan, USA.
KGU, 760kc., Honolulu, Hawaii. Best around 3.0 am.
KOB, 770kc., Albuquerque, New Mexico, USA.
KXA, 770kc., Seattle, Wash., USA.
CKLW, 800kc., Windsor, Ont., Canada.
KGO, 810kc., San Francisco, Calif., USA.
WBAP, 820kc., Fort Worth, Texas, USA.
WFAA, 820kc., Dallas, Texas, USA.
KOA, 850kc., Denver, Col., USA.
XEMO, 860kc., Tijuana, Mexico.
WWL, 870kc., New Orleans, La., USA.
LR6, 870kc., Buenos Aires, Argentina, Sth. A.
XEW, 900kc., Mexico City, Mexico.
KLX, 910kc., Oakland, Cal., USA.
KARK, 920kc., Little Rock, Calif., USA.
KFPY, 920kc., Spokane, Wash., USA.
KHJ, 930kc., Los Angeles, Cal., USA.
CBM, 940kc., Montreal, Quebec, Canada.
KOMO, 950kc., Seattle, Washington, USA.
LR3, 950kc., Buenos Aires, Argentina, Sth. A.
KROW, 960kc., Oakland, Calif., USA.
KOIN, 970kc., Portland, Oregan, USA.
KFWB, 980kc., Los Angeles, Calif., USA.
KMBC, 980kc., Kansas City, Kansas, USA.
CKWX, 980kc., Vancouver, BC, Canada.
CKY, 990kc., Winnipeg, Mon., Canada.
KJR, 1000kc., Seattle, Wash., USA.
CFCN, 1010kc., Calgary, Alta., Canada.
KFVD, 1020kc., Los Angeles, Cal., USA.
WHO, 1040kc., Des Moines, Iowa, USA.
XEAW, 1050kc., Reynosa, Mexico.
KNX, 1070kc., Los Angeles, Calif., USA.*
KRLD, 1080kc., Dallas, Texas, USA.
XERB, 1090kc., Tijuana, Mexico.
KPAS, 1110kc., Pasadena, Calif., USA.
WBT, 1110kc., Charlotte, NC, USA.
KWKH, 1130kc., Shreveport, La., USA.
CBR, 1130kc., Vancouver, BC, Canada.
XENT, 1140kc., Neuvo Loredo, Mexico.
KSL, 1160kc., Salt Lake City, Utah, USA*
KVOO, 1170kc., Tulsa, Oklahoma, USA.*
WOAI, 1200kc., San Antonio, Texas, USA.*
XEB, 1220kc., Mexico City, Mexico.
KFAC, 1250kc., Prt Arthur, Texas, USA.
KYA, 1260kc., San Francisco, Calif., USA.*
CFRN, 1260kc., Edmonton, Alta., Canada.
KLS, 1310kc., Oakland, Cal., USA.
KTRH, 1320kc, Houston, Texas, USA.
KALE, 1330kc., Portland, Oregan, USA.
KCRC, 1390kc., Enid, Oklahoma, USA.
KLPM, 1390kc., Minot, N. Dak., USA.
KGER, 1390kc., Long Beach, Calif., USA.
KERN, 1410kc., Bakersfield, Cal., USA.
KTUL, 1430kc., Tulsa, Okla., USA.
KGNC, 1440kc., Amarillo, Texas, USA.
KXYZ, 1470kc., Houston, Texas, USA.
KSTP, 1500kc., St. Paul, Min., USA. Heard around 11.0 pm.
KGA, 1510kc., Spokane, Wash., USA.
WLAC, 1510kc., Nashville, Ten.
KOMA, 1520kc., Oklahoma City, Okla., USA.
WKBW, 1520kc., Buffalo, NY, USA.
KFBK, 1530kc., Sacramento, Cal., USA.*
WCKY, 1530kc., Cincinatti, Ohio, USA.
KXEL, 1540kc., Waterloo, Iowa, USA.*
XEBG, 1550kc., Tijuana, Mexico. Studios in San Diego, Cal., USA.*
WQXR, 1560kc., New York.
CKTB, 1550kc., St. Catherine, Ont., Canada.
XEAW, 1570kc., Reynosa, Mexico. Studios: Dallas, Texas, USA.
KXKX, 1590kc., Kansas City, Kan., US.

DX reports for the April issue should reach Mr Roy Hallett not later than Saturday, March 6th, 1943. His address is: 36 Baker-street, Enfield, NSW.

THE MONTH ON SHORT WAVES

by Ted Whiting

NEW SHORT-WAVE STATIONS

It seems abundantly clear that we are in a period of transition in which more and more short-wave stations are coming into service. Stations are now being operated in a manner which indicates a better understanding of short-wave propagation. In our last issue, several new stations were listed; others are mentioned in this issue.

WITH the progress of the armies of the United Nations, it is possible to hear more and more countries which are rarely heard here. A case in point is the reception in two states of Australia of the station which has been in use at Reykjavic, Iceland. This one is TJF, and details as to its frequency and operational times will be found in the column dealing with the "New Stations of the Month."

CHANGES EXPECTED

Although at present, in this part of Australia, there are few signs of a return to the reception of stations throughout the forenoon, which change will become evident soon, there are possibilities that this change will be noticed in some districts in the next few weeks. At this time of the year the delay is a new experience and one which is very welcome indeed.

Some very entertaining programmes are to be heard from the BBC in their service to the American continent, which is heard here until 2.45 pm. Signals also can be heard from other countries.

HINTS FOR REPORTERS

We would point out that, in writing these notes, we find that there are many difficulties which are easily overcome with your help.

In order to save time and, in addition, to make for further accuracy, we would request that all reporters, in compiling their very valuable lists, refer to all stations where possible in terms of frequency, as well as in terms of wavelength.

The local time observed at the listening post will, if stated on the list, also assist considerably.

Grouping of stations in the order as published in "Radio and Hobbies" is desirable.

We thank all our readers for the very material assistance they have afforded us in the past, and trust that they will endeavor to help us in these days, when we find time the essential part of the contract.

In addition, the compiling of reports sent to us in this manner will prove to be valuable experience gained for the time when the listener sends reports to stations. In these station reports it is desirable that all facts should be stated in as orderly manner as possible. It is reports of this nature which result in the return of the much-cherished card, and which prove the most value to the engineers of the station concerned.

To those who have questions to ask concerning the short-waves, we would say that we are only too pleased to answer your questions promptly on receipt of the customary stamp for return postage.

So, fellows, go to it and see if we can have a record month of those stations which will soon become audible. There is much scope at present in this way, and we forecast a sudden rise in power consumption on Sunday afternoon!

"WHO'S WHO" CUT OUT

We regret that we have been compelled by the conditions operating at this time to omit the usual "Who's Who" section, which has been on our pages for so long and which was so much appreciated by our many friends.

However, we are sure that they will realise our difficulties in keeping this feature up-to-date. Quite apart from the shortage of space in these war-torn days, there are very few stations which could be dealt with in this section to give them the justice they deserve. Any of our readers who would like information regarding any station are invited to write in and we will include the details in the next issue.

If the information is required with the minimum of delay, we suggest that they enclose the customary stamped and addressed envelope, and we will be pleased to oblige. We hope that, in some measure, this will compensate for the loss of this section.

This month, your short-wave notes have been set in smaller type. They may prove a little more difficult to read but we considered this preferable to reducing the amount of reading matter. When we are able again to increase the number of pages, the clearer type will be restored.

Short-wave reports for the April issue should reach Mr. Ted Whiting not later than Saturday, March 6, 1943. His address is 16 Louden-street, Five Dock, NSW.

FLASHES FROM EVERYWHERE

MEXICO.—Readers will no doubt remember that we stated that XEFT had left the air. This information was from a very good source, but we now find that they are now radiating a programme which can be heard after 4 pm. The station is heard until closing at 5 pm, when they are received at good level. 9550kc. is the frequency.

HAVANA.—Many of our readers, including ourselves, are having a great deal of trouble in the reception of the Cubans. The station we are most interested in is COK, which is not audible here. There are several of our readers who report them each month at the usual times, but as yet we have not heard of them being heard here in the city.

BELGRADE.—This very fine station is very rarely reported in the logs of our readers. They are heard here regularly, and usually seem to put in a good signal. Some very fine music has been heard from here. French is spoken in some of the transmission.

GERMANY.—As will be seen from the station list, many of the stations in the occupied countries are having their call signs changed, presumably to show the world that they are German controlled. So if you hear a new D call, it may be yet another one of the old stations which used to be heard well here.

LONDON.—A change has been made in the frequencies of two of the Empire transmitters. GRM is now heard on 7125kc and GRY on 7272kc. These were heard in announcements from London, otherwise we would have thought that there was a mistake being made.

AFRICA.—In what seems to be an off period for stations from this continent, we find that the best signal is heard at 3.15 am on the new frequency of Nairobi. This station has been heard here putting a good signal in at most times we have listened for him. The other Africans are leaving much to be desired.

ADEN.—The best reports coming in about this one come from Western Australia, but we hope that in the near future we will be able to tell our readers that the station is to be heard at better level.

AZORES.—The station from these islands which we used to hear on 7305kc. is now heard on a new assignment of 11,090kc. 27.15m. A very good signal can be heard at good locations from 6 am till 7 am.

MOROCCO.—The United stations have taken over the broadcasting facilities in Morocco, and therefore we find that an increasing amount of English is to be heard from CNR, of Rabat. This one has been for years a station which could be heard regularly in the early morning. The best time to hear them is at about 7 am, when at times they reach very interesting signal level. The next few months should prove that they can put a good signal in here.

MEXICO.—According to the "Globe Circler," the station in Mexico which is so well heard here as XEWW is now operating on 31.43 metres. This change was made some time ago as a temporary measure, and was reported to us by Mr. McKinnon, who duly despatched a report to them. The signal was a very great improvement over the usual good one we hear each day, so we all hope that the change will come. As yet we find that the station is still on its old frequency.

SWITZERLAND.—The very fine transmissions which have for some time been received on 25.28 metres have been discontinued on that wavelength and are now carried by another transmitter operating on 15,305kc. 19.60m. There is no change in the time of transmission, which takes place at from 7.45 pm till 9.15 pm on Tuesday and Saturday. The early part of this transmission may suffer at this time of the year, but we may hear them fairly well in the near future.

POLAND.—The one-time famous station of Warsaw, SPW, has been reported by Mr. Perkins as being audible at 9.25 pm. This one is rather weak at his location, but has been heard for some time by him. The station operates on 22 metres and classical music is broadcast. We would welcome reports on this one, as we are not able to hear them here.

THIS MONTH'S VERIFICATIONS

CONGO.—Mr. Condon complains that this past month has only yielded one reply to reports sent out. This one is a good one and was accompanied by the schedule which we have published in another section. The verification was in the form of a letter in French, ad for the benefit of others we give the address: M. Haut, Le Chef du Service de l'Information, Cabinet du Gouverneur-General, Leopoldville, Belgian Congo.

HAITI.—Mr. Cushen has received a card from HHBM, located at Port-au-Prince, which states that they are soon to add two new frequencies to their schedule. The power of this one is only 450 watts, so they are an exceptionally good catch.

AMERICA.—In a letter from WCDA, Mr. Cushen received the information that WCDA is operating on 9590kc. at 9 pm till 11 pm. 12.15 am till 12.45 am, and 6.15 am till 7.45 am, and also on 7830kc. at from 7.55 am till 2 pm. This station is being reported in all transmissions from various parts of the country.

AMERICA.—A card was received by Mr. Morris regarding transmission of KWID and also WRCA. The usual frequency list was also sent, and a letter of appreciation was enclosed. The authorities are always pleased to get reports on their stations.

Miss Sanderson also breaks into the game by announcing the arrival of cards from KWV and All India Radio, and letters from WGEO and another card from CBFY.

BRAZIL.—Mr. Cushen writes to say he has received letters from PPH and PCQ, which are located in Brazil. For those who may hear these stations, we give the address: Radio Club of Brazil, Avendia Rio Branco, 181-3, Rio de Janeiro. Verifications are also to hand from CBRX, KWID and WCRC. Very fine work for one month.

NEW STATIONS OF THE MONTH

AMERICA—AFRICA—AUSTRALIA—NORWAY

TFJ, ICELAND.—The reception of a station from Iceland is very much an event at any time, and we cannot recall a station which has been so sought after for the many years which TFJ has been operating. We believe that Mr. Simpson was the proud possessor of a card from this station, but we have no record of the frequency on which he heard them. Mr. Condon and Mr. Walker have both reported this one, and they have heard them at widely different times. On Wednesdays they are heard contacting the NBC at 10 am till 10.30 am, apparently in English. Mr Condon heard them at from 4.15 pm till 4.30 pm, using the Danish language and closing with the National Anthem of Denmark. The station is operating on 12,235kc., 24.52m.

VLI, SYDNEY.—Although we are not listing all the stations operating under this call in this section, readers will find the details on reference to the station list. This call has been taken up in preference to the VLQ call which has been in use for the past few months.

RADIO CONGO-BELGE.—Four new frequencies are in operation from Leopoldville. These are given in a separate article, so we will not repeat them here. These new ones should provide some of our country listeners with some new scalps, at a time when we city dwellers are not able to hear stations on these frequencies.

ZOY, ACCRA.—This station was unfortunately omitted from last month's issue, due to the demand on the space. Mr. Gillett reported hearing them on a new frequency of 7284kc. This corresponds to 41.2 metres. To those who are listening in the morning, they are to be heard at about 6.15 am on closing. The strength is quite good here, and we have no doubt that they will be much better as the seasons change.

KWY, SAN FRANCISCO.—Another one which should have made it last month was KWY, which has taken over one of the relays of KWID in lieu of KWV. They operate on 7560kc., 39.68m. We have heard them many times, but they have never reached the standard set by their sister station. However, we have hopes that they may come good one day.

WHL6, NEW YORK.—As has been customary for the last few months, we have yet more Americans which are new to the air. This one is now operating on 13,483kc., 22.25m., and has been reported as being heard well in a session in English at 7 am daily. Mr Condon was the first reporter to bring this one to our attention, but many readers have since reported the station.

WOO4, NEW YORK.—Another new station in the foreign services which are maintained by the American authorities. WOO4 is heard at 7.30 pm operating on 8759kc., 34.25m., with a fairly good signal. The language mostly heard is French, and frequent news is read in that language.

DXI, NORWAY.—Among the many stations that have been taken over by the German authorities in occupied countries, it has become the habit to change the call. This has been done in the case of the Oslo station. This station is to be heard on opening at 6.30 am and is heard with a very good signal. As yet, we have not heard any English from this transmitter, and this applies to Mr. Condon, who has heard this station also.

WJQ, NEW YORK.—This one-time very popular station is now heard to better advantage than recently on a new frequency of 7820kc., 38.40m. We have heard this one in the last few nights at very fine strength at about 10 pm. The change became evident at the beginning of February. Many of our readers are experiencing difficulty getting a card from this station. It does not seem to be known in America, and at least to the postal people. We can only suggest that we have another try for a card for this new frequency. Remember that American secondary transmitters do not always verify.

WITH OUR S.W. REPORTERS

Mr. A. E. Moore, Brisbane, Queensland.

We once more return to the pineapple State to review the activities of a listener who has been casting his ears over the Short Waves for many moons. This listener has been supplying us with reports for the past two years, and during the time that we have been associated with this work we always find in his log one of these elusive stations.

INVERTED L AERIAL

The old standby, in the form of the inverted L aerial, is in use at this post, and it is an imposing affair, standing some 30 feet high. The length of the flat top is 75 feet running NW to SE. An earth is also in use and is formed by means of a connection to the water pipe.

Although the location is surrounded by all those devices which so often mean a lot of interference, the actual interference experienced is very little. Apparently this gentleman is very lucky indeed, and does not have the trouble that so many of us are experiencing.

No fewer than 81 cards have been received from some 24 countries, and these include many from some of the hardest stations to receive. It is all the more meritorious when it is recalled that all this has been achieved in just on two years, at a time when a verification is more of a rarity than in former years.

DUAL-WAVE RECEIVER

The receiver used at Mr. Moore's listening post is a commercial model which employs six valves of the European type. The circuit arrangement consists of an RF stage, followed in turn by a converter, an IF stage, second detector, and audio stage.

Coils are switched to cover the B/c band and one Short Wave band of from 16 metres to 50 metres.

Mr. Moore has read "Radio and Hobbies" since its inception, and declares that his favorite sections are the constructional articles, The Month On Short Waves, and With Our S.W. Reporters. He is very appreciative in his remarks as to the help this magazine has given him in his many hours at the dials of his receiver.

REPORTS FROM OUR READERS

The following readers have sent us reports and letters, for which we express our thanks:—

J. Shiel, Melbourne, Vic.
B. Stern, Bondi, NSW.
L. Walker, Applecross, WA.
A. S. Condon, Laura, SA.
H. Perkins, Malanda, Q.
R. G. Nichols, Berri, SA.
A. T. Johnson, Maylands, WA.
J. Teare, Oakleigh, Vic.
R. Nolan, West Perth, WA.
E. Larson, Footscray, Vic.
J. W. Swingle, Hawthorne, Q.
N. Gunner, Stanmore, NSW.
M. Morris, Merewether, NSW.
A. T. Cushen, Invercargill, NZ.
J. Thornewaite, Drummoyne, NSW.
J. A. Bate, Merriwa, NSW.
A. H. Wass, Wagga, NSW.
B. M. Walker, Linwood, NZ.
Dr. K. B. Gaden, Quilpie, Q.
R. Fisher, Caulfield, Vic.
A. Lee, Merewether, NSW.
W. Harvey, Dubbo, NSW.
G. Smart, South Caulfield, Vic.
R. G. Gillett, Dudley Park, SA.
K. P. Nicholson, Glen Iris, Vic.
Miss D. Sanderson, Malvern, Vic.
R. Hallett, Enfield, NSW.
A. C. Jamieson, South Yarra, Vic.
J. D. Harrington, Cremorne, NSW.
L. H. Poynter, Melbourne, Vic.

SCHEDULE FROM RADIO CONGE-BELGE

Mr. Condon recently received a schedule from this station which he kindly forwarded to us. The old outlet on 10.040kc. has been discontinued, and the following is the schedule now in operation from this outpost of Africa:—

OPL—20,040kc. 14.97m., 9.25 pm to 10.45 pm East.

OP?—17,775kc. 16.88m., 9.25 pm to 10.45 pm East.

OP?—11,720kc. 25.60m., 9.25 pm to 10.45 pm East.

OP?—6280kc. 47.78m., 9.25 pm to 10.45 pm East.

OP?—17,775kc. 16.88m., 5 am to 7 am.

OP?—11,720kc 25.60m., 5 am to 7 am.

OP?—6280kc. 47.78m., 5 am to 7 am.

We will be pleased to receive any reports regarding these stations, so that we can judge the most suitable frequencies for transmission to this country.

MYSTERY STATIONS

This month we present what we think will become a very interesting mystery station. This one was heard by Mr. Condon.

The station was heard at 7.30 am with an announcement stating that "This is National Broadcasting Station ERIP." No location was given, and this announcement was followed by announcements in French, and then music. The signal faded out at 8.10 am. This one has defied us, as we cannot hear them, but are living in hopes. The station operates on approximately 6097kc., and was heard with a fair signal in South Australia.

Mr. Cushen also supplies a mystery station which he lists as operating on 15,200kc. He has heard them signing off at noon with Hawaiian music. News in Spanish was heard at 11.30 am, and the only call heard was Radio National. This one has defied his attempts at identification, so maybe one of our New Zealand listeners will be able to help him. It is very unlikely that this one will be heard here at this time. It is the prerogative of New Zealand to be able to hear these stations in daylight hours.

Readers will remember that our DX colleague, Mr. Roy Hallett, reported a station of the broadcast band which had been puzzling the authorities in New Zealand. This month Mr. Hallett reports that the mystery has apparently been cleared up by the arrest of a twenty-year-old youth, who had been operating a one-watt transmitter from his home.

Mr. Stern reports that he has heard an unidentified station on 5300kc. radiating a very similar type of programme to that which had been coming from the New Zealand "pirate." If there is any connection between the two signals, then the matter will have been cleared up. However, it may be from another source altogether.

While the operation of a "pirate" transmitter may be regarded in normal times as an undesirable prank of an irresponsible enthusiast, it takes on a grimmer note in wartime. With the enemy hammering at our gate in the near north, too much emphasis cannot be laid on the importance of preventing all possible leakage of information, intentional or otherwise. We trust that our short-wave enthusiasts will be vigilant against any misguided person who thinks it smart to radiate any signal whatever from his aerial system.

OTHER ITEMS

FOLLOWING our paragraph to the effect that in future we are giving more prominence to the frequency of stations in our columns, we have had many letters of inquiry as to the method adopted in converting these figures from one to the other.

The method is simple mathematically, since either of these figures is converted to the other by dividing into 300,000.

We would add that the figures for both wavelength and frequency will be given in the station list as in the past.

* * *

SOME very fine transmissions are heard from Sweden, and now their station, SBP, is on a new schedule, and it is to be heard only on Sunday night at 10 o'clock. Some very fine orchestral music is heard, and it is possible to obtain a vertification from them via the American, Swedish Exchange, New York.

* * *

A NEW station has been opened in Calais, France, undoubtedly for the purpose of disseminating more propaganda. This one is not heard here as yet, but is being heard in the West and South on 15,120kc. The station has been heard at one location at midnight, and at another closing at 12.45 am. Announcements have been heard in English.

OVERSEAS S.W. STATIONS NOW AUDIBLE

The list of stations shown below comprises only those which have actually been heard in this country during the past few weeks, and does not include stations which are on the air but not heard as yet in this country. A large majority should be heard on any sensitive receiver, and when a station is reported for the first time readers' names who report it are shown in brackets. At the end of each group is a list of correspondents who have sent in reports.

ENGLAND

GSA—6050kc. 49.59m. London. Heard at very good level on most mornings and afternoons at 6 am and 6 pm.

GSB—9510kc. 31.55m. One of the well-worked transmitters. Is used in the Eastern, Pacific, and Latin American services.

GSC—9580kc. 31.32m. Is used in the North American service. Heard best at 7.30 am.

GSD—11,750kc. 25.53m. One of the reliable transmitters. Is heard in all services except the Pacific. Good signal in the forenoon on some mornings.

GSE—11,860kc. 25.29m. Heard one evening at 9 pm. Fair signal.

GSF—15,140kc. 19.82m. Another transmitter which is heard well. This one is excellent at opening of Eastern service. Also heard in Pacific and African services.

GSG—17,790kc. 16.86m. Has been reported as heard in foreign service at 10 pm. Good signal.

GSH—21,470kc. 13.97m. This one is heard most nights at 9.45 pm in Eastern service. The strength is often good.

GSI—15,260kc. 19.66m. Used in the Pacific and Eastern services. Good signal when operating.

GSL—6110kc. 49.19m. This one is not included in the Pacific list, but has been heard carrying the same programme on occasions. Heard also on occasions in the European service at 4.30 am.

GSN—11,820kc. 25.38m. Good signal in the European service at 2.30 am. Also at 12 midnight in same service.

GSO—15,180kc. 19.76m. Foreign transmission from this one at midnight. Good signal when conditions are good.

GSP—15,310kc. 19.60m. Pacific service station. Signal here is not so good.

GSV—17,810kc. 16.84m. Used to good advantage in Pacific service and in Eastern service. Excellent signal here.

GSW—7230kc. 41.49m. Now used in European service at 6 pm. Good signal.

GRA—17,715kc. 16.94m. This new one is heard at from 7.15 pm till 10 pm. News in English and German is read. Good signal.

GRD—15,450kc. 19.42m. Pacific and Eastern services for this one. Good in latter transmission.

GRE—15,390kc. 19.49m. Heard well at midnight in Eastern service. Also used in Pacific service.

GRF—12,095kc. 24.80m. Has not been heard in forenoon lately. Will be glad of reports of this one.

GRG—11,680kc. 25.68m. Used in Pacific, African and North American service. Good reception in Pacific transmission.

GRH—9825kc. 30.53m. This one is excellent in Pacific transmission. Also heard in North American and Eastern service.

GRI—9415kc. 31.86m. This one has been in service for the troops in North Africa. Heard here at 9 pm one night.

GRJ—7320kc. 40.98m. European service at 7.30 am daily.

GRK—7185kc. 41.75m. This transmitter is heard in Home service at 4 am and 7 pm.

GRM—7125kc. 42.13m. Has been taken into Pacific service .. Excellent signal. Is also heard irregularly at other times.

GRN—6195kc. 48.43m. Heard at 6 am when noise allows. Will improve.

GRO—6180kc. 48.54m. This transmitter is used in African service. Good signal at 4 am.

GRP—17,890kc. 16.77m. Has not been heard for some time.

GRQ—18,025kc. 16.64m. The same remarks apply to this one.

GRR—6080kc. 49.34m. Home service station which is heard at 3 am and 5 pm. Good signal at both times.

GRS—7065kc. 42.46m. Is no longer in the Pacific service. No reports of other transmission.

GRU—9450kc. 31.75m. An African service transmitter Heard at 3 am with good signal.

GRV—12,040kc. 24.04m. Pacific service at 6 pm. No reports for other times.

GRW—6140kc. 48.86m. Home service station heard at 6 am. Excellent signal on one occasion we heard them.

GRX—9690kc. 30.96m. Heard well at 7.45 pm in news in English. Is used in Home and European service.

GRY—7272kc. 41.25m. This new frequency for this one was tried out some months ago. Used in Pacific service directed to Africa Has been heard here at fair strength.

GRZ—21,640kc. 13.86m. Heard from 9 pm in French and later joins the Eastern service for the news at 10 pm. Good signal on most nights.

GVO—16,080kc. 16.59m. This one is also in Eastern service at 9.45 pm.

The following readers have reported stations in the above group: Messrs. Condon, Perkins, Larson, Nolan, Gunner, Walker, Stern, Sheil, Bate, Wass, Gaden, Fisher, Lee, Smart, Morris, Miss Sanderson.

INDIA AND ASIA

Jacutta Radio—18.135kc. 16.54m. Batavia. The new name for this one is used now. Heard at good level.

VUD2—7290kc. 41.14m. Delhi. Heard nightly at 10.30 pm. Fair at an earlier hour.

VUD2—6190kc. 47.47m. Same location. Is scheduled to be on air at from noon till 2.35 pm. Still not reported from city areas.

VUD?—6005kc. 49.94m. Same location. Heard in parallel with VUD4 at midnight.

VUD2—4890kc. 60.40m. Same location. Scheduled to be on air at from 12.35 am till 3.15 am.

VUD3—15,290kc. 19.62m. Same location. Heard at excellent level in afternoon. Good also at 9.30 pm.

VUD3—11,830kc. 25.36m. Same location. Heard every night at good strength at 11.30 pm.

VUD3—6085kc. 49.30m. Heard between 2.30 am and 5 am. Good signal.

VUD4—9590kc. 31.30m. Can be heard daily at any time after 5 pm.

VUD6—11,790kc. 25.45m. Same location. Heard between 6 pm and 7 pm and also after 10 pm.

VUD6—7270kc. 41.27m. Same location. Heard at best level at from 2.30 am till 5 am.

VUD?—966kc. 31.04m. Same location. Heard in transmission in Hindustani at 10 pm.

VUB2—7240kc. 41.44m. Bombay. Very good at night in news at 11.30 pm.

VUB2—6085kc. 49.30m. Same location. On schedule from noon till 2 pm.

VUB2—4880kc. 61.48m. Same location. 1 am till 3.15 am is the time for this transmitter.

VUM2—7270kc. 41.27m. Madras. Heard well at from 2.30 am till 2.50 am.

VUM2—6150kc. 48.78m. Same location. This one is on the air and can be heard at from 11.30 am till 1.30 pm. Is reported from the country.

VUM2—4920kc. 60.98m. Same location. Is to be heard from 11.30 pm till 1.30 am.

VUC2—7210kc. 41.67m. Calcutta. Also heard well in news at 11.30 pm. This is one of the best at this time.

VUC2—6010kc. 49.92m. Same location. Is on the air from noon till 3 pm.

WHEN AND WHERE TO LISTEN

6 a.m. TILL NOON

TPZ2—8960kc. Algiers. Very good at 6 am.

HVJ—5969kc. Vatican City. Heard well at 6.15 am daily.

WGEO—9530kc. New York. News read at 7 am.

CSW6—11040kc. Lisbon. A good signal at 6.15 am.

DJX—9675kc. Berlin. Also in news at 7.15 am.

KWU—15355kc. San Francisco. Listen for this one at 8.15 am.

GSO—9580kc. London. Strong signal at 8.45 am.

Batavia—18135kc. Java. News at 9 am.

JLG4—15105kc. Tokio. Good in most parts at 11 am.

Best listening period at from 6 am till 9 am.

NOON TILL 6 p.m.

KWID—15290kc. San Francisco. Heard at fair strength in places at Noon.

JLG4—15105kc. Tokio. News again at 1 pm.

VUD3—15290kc. Delhi. Heard well at opening at 2.30 pm.

2RO3—9630kc. Rome. A good signal at 4 pm.

WNBI—9670kc. New York. Very welcome signal at 5 pm.

FZI—11970kc. Brazzaville. Fair at 5 pm.

GRH—9825kc. London. This one is excellent at 5 pm.

GRM—7125kc. London. Invariably good at 5 pm.

KWV—10840kc. San Francisco. Very good at 5.15 pm.

Best listening period at from 4 pm till 6 pm.

6 p.m. TILL MIDNIGHT

FK8AA—6160kc. Noumea. Heard at good strength at 6.15 pm.

GRX—9690kc. London. A good one at 8 pm.

KWID—9570kc. San Francisco. Best at 8.45 pm.

VUD2—15290kc. Delhi. Strong at 9.30pm.

JZJ—11800kc. Tokio. Very loud at 9.30 pm.

DJR—15340kc. Berlin. Excellent at 9.30 pm.

Saigon—11780kc. Indo-China. Still good in News at 10.30 pm.

Moscow—10445kc. Russia. Excellent at 10.40 pm.

XGOY—6130kc. Chungking. Very good in news at 11.30 pm.

Best listening period at from 7 pm till 11 pm.

SHORT WAVES

VUC2—4840kc. 61.93m. Same location. This one is scheduled to be on from midnight till 3 am.

VWY—9045kc. 33.17m. Kirkee. Service to Syria has been heard again. Good strength at 4.30 am.

Radio Shanghai—11,970kc 25.06m. Indian Independence League. Heard each day from 10.30 pm till 1 am.

XGOA—9820kc. 30.86m. Chungking. Heard at good strength at 10.30 pm till midnight.

XGOY—11,900kc. 25.21m. Same location. Heard well from 7.30 pm till midnight.

XGOY—9625kc. 31.17m. Same location. Is heard well at midnight with news.

XGOY—6135kc. 48.90m. Same location. Heard calling San Francisco from midnight till 12.30 am.

XGOY—5950kc. 50.42m. Same location. Heard very well from 11.30 pm. News is read at this time. Very good.

XGOX—15,200kc. 19.74m. Same location. Is reported as carrying news at 8.30 pm.

XGOI—9300kc. 32.26m. Shanghai. Has been reported this month. Heard after 10.30 pm daily.

XGOI—9665kc. 31.04m. Same location. News in English is heard at 11.15 pm.

XGOK—11,650kc. 25.75m. Canton. Has not been heard here lately.

XGAW—6090kc. 49.25m. Shanghai. Heard at 10.45 pm. with American announcer. Very good signal.

XGRS—11,640kc. 25.77m. Same location. Heard daily. Always good signal from this German-owned station.

XPRA—9830kc. 30.51m. Kweiyang. Heard at good level at 10.30 pm.

XPSA—8465kc. 35.44m. Same location. Still carries the native type programme we have heard from here for so long.

XGAP—10,270kc. 29.20m. Peking. This one has been heard much earlier than midnight lately. 10.30 pm on some nights it has been good.

XGAP—6100kc. 49.18m. Same location. This one is heard well at from 11.30 pm daily.

XLMA—9350kc. 32.09m. Shanghai. Is not so good at this location. Has been reported from interstate as being very good at 11.30 pm.

XMHA—11,855kc. 25.30m. Same location. Audible from 9 pm with very good signal.

XIRS—11,980kc. 25.02m. Same location. Their transmissions have been very quiet lately. Italian owned.

FFZ—12,060kc. 24.88m. Same location. This one is in our opinion the most improved station of the month. Has been heard well here from 9 pm.

JQHA—9470kc. 31.68m. Hongkong. Heard well from 11 pm.

MTCY—9545kc. 31.43m. Hsingking, Manchuria. This one is the only Manchu transmission heard this month.

Saigon—11,780kc. 25.47m. French Indo-China. This one is a star. It is now heard in the morning and evening as well as at night. Is on from 11.45 am till 12.25 pm. Closes at 5.45 pm.

CR8AA—6250kc. 48.00m. Macao, Portuguese China. Is still heard in some locations.

HSP5—11,715kc. 25.61m. Bangkok, Thailand. Heard every night at 11 pm. Lady announcer.

Voice of Thailand—7190kc. 41.72m. Same location. Good on closing at 12.45 am.

Thailand Radio—6057kc. 49.53m. Same location. This one is on at terrific level at midnight.

KZRH—9640kc. 31.12m. Manila, PI. Has been heard at fair strength most nights. Male American announcer. 9 pm is the best time.

EQB—6155kc. 47.74m. Teheran, Iran. This one is heard in an English transmission at from 5.45 am. Fair signal.

E??—8110kc. 36.99m. Same location. Seems to take the same programme as EQB, but uses French from 7 am till 8 am. Noisy on this band.

XYZ—6007kc. 49.94m. Rangoon, Burma. This station is weak now and is heard at 11 pm.

ZHJ—6095kc. 49.21m. Penang. Heard at same time, but is at much better level. News is read at 11.30 pm.

JZU4—17,780kc. 16.87m. Tokio. News is read at 7 pm till 7.15 pm. Good signal.

JLG6—15,102kc. 19.86m. Same location. Heard in the morning at 9 am. Best at night in transmission from 8 pm.

JZJ—11,800kc. 25.42m. Same location. Heard well from opening at 7 pm. Fine signal throughout night.

JLG2—9948kc. 31.57m. Same location. Heard at 10 pm at very good strength.

JVW—7257kc. 41.34m. Same location. Listen for this one at 7.30 pm in Japanese. Good transmission.

ZNR2—10,285kc. 28.88m. Aden, Arabia. Can be heard weakly opening at 3.15 am. Heard much better in the west than at this location.

Radio Levant—8030kc. 37.34m. Beirut, Syria. Can be heard well at 3.30 am. This one verifies with nice letter.

Singapore—12,000kc. 25.0m. Heard well at 11 pm, and is now reported at 10.45 am.

The following readers have reported stations in the above group:—Messrs. Condon, Perkins, Larson, Nolan, Johnson, Cushen, Morris, Gunner, Walker, Stern, Shiel, Bate, Wass, Gaden, Fisher, Lee, Harvey, Smart, Gillett, Nicholson, Hallett, Miss Sanderson.

NORTH AMERICA

WGEA—15,330kc. 19.57m. Schnectady. News is heard at 1.15 am. Good strength.

WGEA—9550kc. 31.42m. Same location. Heard well in the morning when they open at 9 am.

WGEA—6190kc. 48.47m. Same location. Opens at 9.30 pm, when they are audible at varying level.

WGEO—11,847kc. 25.33m. Same location. This other outlet opens at 12.1 am and is heard at periods of the transmission which closes at 11 am. The service is directed to Europe.

WGEO—9650kc. 31.08m. Same location. The service to Australia and the South Pacific is heard from 8 pm till 11 pm. Good transmission, especially after 9 pm.

WGEO—9530kc. 31.48m. Same location. Heard in the morning at 9 am till 10 am.

WNBI—17,780kc. 16.87m. New York. This signal is to be heard at 1 am and on a good day at 10 am.

WNBI—15,150kc. 19.81m. Same location. This one is on the air at 10 am daily.

WROA—11,890kc. 25.23m. Same location. Is audible some nights at midnight.

WNBI—9670kc. 31.02m. Same location. Heard in afternoon transmission. This one is excellent at 4.15 pm.

WCBX—15.270kc. 19.64m. Same location. A transmission for Europe is carried here at 1.30 am. Also to be heard in the forenoon at 11 am.

WCBX—11,830kc. 25.36m. Same location. The French language transmission is heard from 9 pm till after midnight.

WCDA—17,830kc. 16.80m. New York. News in Spanish at 8 am till 10 am. News in English at noon.

All times mentioned in these columns are Eastern Australian Summer Time.

WCDA—11,830kc. 25.36m. Same location. Foreign language programme heard at 7.30 am.

WCDA—9590kc. 31.28m. Same location. Listen for the news in English at 9.30 pm.

WLWO—15,250kc. 19.67m. Cincinnati, Ohio. The best time for this is at 9 am or 6 pm.

WLWO—11,710kc. 25.62m. Same location. This one is heard at 11 am when conditions are suitable.

WLWO—9590kc. 31.28m. Same location. This one opens at 11 am. Spanish is spoken.

WLWO—6079kc. 49.34m. Same location. Heard frequently at 7 pm.

WBOS—15,210kc. 19.72m. Boston, Mass. This one is heard in news at midnight.

WBOS—11,870kc. 25.27m. Same location. Listen for this one at 9.30 am.

WBOS—6143kc. 48.85m. Same location. Has been logged recently at 7 pm, but a little later is usually better.

WRUL—17,751kc. 16.90m. Same location. At 11.30 pm it is sometimes possible to follow this station.

WRUL—11,790kc. 25.45m. Same location. News is read at 7.30 am and 9.30 pm. A good signal at both times.

WRUW—15,350kc. 19.54m. Same location. Opens very well at 1.15 am. This one we also located at Boston.

WRUW—11,730kc. 25.58m. Same location. One of the best stations on the air at 10 am.

WRUW—9700kc. 30.93m. Same location. Used in a foreign service to Europe

WCB—15,580kc. 19.26m. New York. Heard well in the morning at from 8.15 am till 9 am. Good signal.

WCR—9400kc. 31.92m. Same location. This one is also on the air in the morning at 10 am.

WCW—15.850kc. 18.90m. Same location. Opens at 8 am. News at 9 am, and closes at 10 am. Can also be heard at 1 am.

WDJ—7556kc. 39.70m. Same location. English transmission from 6.45 pm till 9 pm. This one is not so good.

WDL—9570kc. 30.77m. Same location. Is on the air from 7.15 am till 10.15 am.

WDO—14,470kc. 20.73m. Same location. Can hear this one from 7.45 am till 9.45 am. Good signal throughout.

WGI—5345kc. 59.40m. Same location. Seems to be out of service these days.

WHL5—9904kc. 30.29m. Same location. Quite a good signal from 7.40 am till 10.15 am.

WHL6—13,483kc. 22.25m. Same location. English service at 7 am can be heard well.

WJP—8810kc. 34.05m. Same location. Heard fairly well at from 9 am till 10 am.

WJQ—7820kc. 38.40m. Same location. The service is now carried out on this new frequency.

WJP—8900kc. 34.09m. Same location. News is to be heard at 10 am. At a good location would be like a local.

WOK—10,555kc. 28.42m. Same location. News in Spanish is read at 9.30 am. In English at 10 am. Good signal from this one.

WOO4—8759kc. 34.25m. Same location. Listen for this one at 8.15 pm in French. Usually good level.

KGEI—15,210kc. 19.72m. San Francisco. Is on schedule from 8 am till 11.45 pm. Has been very disappointing this summer.

KGEI—11,730kc. 25.58m. Same location. Has been the best of a bad lot of this group of stations. Is on from 3.15 pm till 6 pm. Fair at 5 pm.

KGEI—9550kc. 31.41m. Same location. Heard at from 7 pm till 3 am. Good at 10 pm.

KGEI—7250kc. 41.38m. Same location. Heard best at 9 pm. Closes at 4 am.

KEI—9991kc. 31.61m. Same location. Heard on some days at 4 pm relaying KGEI. Reaches a fair signal at times.

KWID—15,290kc. 19.62m. Same location. Heard from noon till 6 pm. On some days is fair at this location.

KWID—9570kc. 31.35m. Same location. This one is on the air from 6 pm till 9 pm. Good signal.

KWID—7230kc. 41.49m. Same location. This one can be heard from 9.15 pm till 12.30 am. Mostly good transmission.

KWV—10,840kc. 27.68m. Same location. Relays KWID from 5 pm till 7.30 pm. A good one as a rule.

KWU—15,355kc. 19.53m. Same location. This is good each morning at 7.30 am till 9 am.

KWY—7560kc. 39.68m. Same location. Relay of KWID from 7.30 pm till 10.5 pm.

KKQ—11,950kc. 25.11m. Bolinas. Has been heard in commercial point-to-point transmission at 3 pm.

KLL—13,740kc. 21.87m. Same location. This one has been used in same type of transmission, but at 7 am.

CBFY—11,705kc. 25.63m. Montreal, Canada. Can be heard at fair strength at midnight.

CFRX—6070kc. 49.42m. Toronto. This one is reported to us regularly as heard at midnight.

CJCX—6020kc. 49.83m. Sydney, NS. Occasionally heard at 11 pm. Weak here.

CBRX—6160kc. 48.70m. Vancouver. Have not heard this one for some time.

XEWW—9503kc. 31.57m. Mexico City. This one is best at 4.30 pm, but is also heard at some locations at 11.30 pm.

XEFT—9550kc. 31.40m. Same location. Back on the air, and is heard at 5 pm, when they close at good strength.

The following readers have reported stations in the above group:—Messrs. Condon, Perkins, Nichols, Larson, Nolan, Johnson, Cushen, Morris, Gunner, Walker, Stern, Shiel, Bate, Wass, Walker (NZ), Gaden, Lee, Fisher, Harvey, Smart, Gillett, Nicholson, Hallett.

CENTRAL AMERICA AND WEST INDIES

HP5A—11,700kc. 25.64m. Panama City. Heard at midnight, and also in some locations at 9 am.

HP5G—11,780kc. 25.47m. Same location. Is reported by some reporters, but here is impossible, due to Saigon's terrific signal.

HP5J—9607kc. 31.23m. Same location. This one is also on the air at 11 pm.

HH3W—10,130kc. 29.62m. Port au Prince, Haiti. This one is heard at 7 am. French and Spanish are the languages used.

H12G—9295kc. 32.28m. Cuidad Trujillo, Dominican Republic. Opens at 8.15 am. This one will be on the improve.

TIEP—6692kc. 44.81m. San Jose, Costa Rica. This one is to be heard at 10.45 pm. The strength at present is weak.

TIEMC—11,900kc. 25.21m. Same location. This station is to be heard at from 11 pm.

TIPG—9620kc. 31.19m. Same location. Listen for this one at 11 pm.

TILS—6165kc. 48.66m. Same location. Will in a few weeks be audible at 4 pm on Sunday.

TI4NRH—9740kc. 30.80m. Heredia, Costa Rica. Look for them at 3 pm till 4 pm Sunday and at 11 pm nightly.

TGWA—15,170kc. 19.78m. Guatemala City, Guatemala. Monday morning only for this. Can be heard at 8.30 pm. Closes at 8.45 pm.

TGWA—9685kc. 30.98m. Same location. This will be showing up at 3 pm daily and on Sunday till 5 pm.

YNRS—8585kc. 34.95m. Managua, Nicaragua. Reports on this one will be appreciated. Used to be heard at 11 pm.

COBC—9695kc. 30.94m. Havana, Cuba. This frequency is now not in use.

COBC—9365kc. 32.05m. Same location. This one is reported as heard at 9 am.

COCH—9435kc. 31.80m. Same location. Some of our readers report this station at 10.45 pm.

COCO—8700kc. 34.48m. Same location. English is used when this one is heard at 11 pm.

COCQ—6375kc. 47.06m. Same location. Often puts in a fair signal at 10.40 pm. We cannot hear them here.

COCQ—8850kc. 33.90m. Same location. This station should be heard at 9 pm.

COCX—9270kc. 32.36m. Same location. Best time to try for them is at 7 am.

COK—11,620kc. 25.88m. Same location. Is reported as best at 8.15 am. This station has not been heard here for some time.

The following readers have reported stations in the above group:—Messrs. Condon, Nolan, Cushen, Walker, Gaden, Gillett.

NEW STATION LOGGINGS

Call.	KC.	W/L.	LOCATION.
TFJ	12235	24.52	Reykjavic.
VLI2	11870	25.27	Sydney.
VLI3	15320	19.59	Sydney.
VLI6	9590	31.28	Sydney.
VLI7	11880	25.25	Sydney.
ZOY	7284	41.2	Accra.
KWY	7560	39.68	San Francisco.
WHL6	13483	22.25	New York.
WOO4	8759	34.25	New York.
DXI	6198	48.41	Oslo.
WJQ	7820	38.40	New York.

SOUTH AMERICA

HCQRX—5972kc. 50.23m. Quito, Ecuador. Should be audible now at 10.45 pm.

HCJB—12,460kc. 24.08m. Same location. Still on the air on Monday morning. Also heard at 11.30 pm. Good signal.

HCJB—10,000kc. 30.0m. Same location. Have any of you fellows heard them at 1 pm till 2 pm?

HJCD—6160kc. 48.70m. Bogota, Columbia. This station is heard in NZ at 1.30 pm.

HJCF—6240kc. 48.07m. Same location. Also heard in NZ at the same time.

HJCX—6018kc. 49.85m. Same location. Listen for them at 11 pm. Fair at times.

CB960—9600kc. 31.25m. Santiago, Chile. One for Sunday afternoon at 4.15 pm.

CB970—9735kc. 30.82m. Valparaiso. Heard daily at fair strength at 10.30 pm.

CB1170—11,700kc. 25.64m. Same location. Try at 3 pm until 3.30 pm for this one.

CB1180—11,975kc. 25.05m. Same location. Is heard at good level at 10.30 pm nightly.

OAX1A—6290kc. 47.69m. Chicaylo, Peru. Another one heard in NZ at 2 pm.

OAX4J—9340kc. 32.12m. Lima. To be heard at 8 am and 3 pm on Sunday.

OAX4G—6190kc. 48.47m. Same location. Sunday afternoon at 3.30 pm.

OAX5C—9540kc. 31.45m. Same location. Good one now at 4 pm Sunday afternoon.

CXA8—9640kc. 31.12m. Colonia, Uruguay. The best time is 7 am daily, and in addition 5 pm on Sunday.

PSH—10,220kc. 29.35m. Rio de Janeiro, Brazil. Weak signal at 10 am Saturday.

PSF—14,690kc. 20.42m. Same location. Same programme at same time, but is a little stronger.

PRE9—6105kc. 49.14m. Fortazela. Heard opening at 8 am.

LSX—10,357kc. 28.98m. Buenos Aires, Argentina. Weak at 10 am.

LRX—9662kc. 31.06m. Same location. Also on the same programme from 9.30 am for a half-hour. Just heard at times.

The following readers have reported stations in the above group:—Messrs. Condon, Cushen.

AFRICA

ZOY—6002kc. 49.98m. Accra, Gold Coast. Heard at good strength at 6 am. Is on the air from 4 am till 9 am.

ZRK—6097kc. 49.20m. Capetown, S. Africa. Heard at 7.45 am. Weak.

ZRH—6007kc. 49.95m. Johannesburg. Is heard at best at 7 am till closing at 7.30 am.

ZNB—5900kc. 50.85m. Mafeking. Same times again.

—5962kc. 50.23m. Location is not known. Keeps same hours.

alisbury—19.0m. This one is an experimental frequency used by the Post Office station. We are listening for this one. Like to join us? About 4 am is the time.

UX—7865kc. 38.15m. Cairo, Egypt. A good one in Arabic at 7 am.

UP2—6320kc. 47.47m. Heard in places at 3.30 am till 4.30 am.

adio Cairo—5980kc. 50.17m. Still heard at 7 am.

adio Addis Ababa—9620kc. 31.18m. Abyssinia. Can hear this one at 3 am. Closes at 5 am in English.

adio Tananarive—6162kc. 48.68m. Madagascar. Uses French when heard at 1.30 am. Good signal.

R7BD—15,250kc. 19.66m. Portuguese West Africa. Best time is at 8 am.

R7AA—6300kc. 49.71m. Same location. Same time in the morning.

ZI—11,970kc. 25.06m. Same location. A very interesting station. Heard in French at 6 am and 4.30 pm.

ad.o Cameroun—8000kc. 37.50m. Douala. The only times to listen for this one is at 3.15 am and at 7 45 pm. The former looks the most likely. We are also listening for this one.

PM—11,720kc. 25.60m. Leopoldville, Belgian Congo. Another one we are interested in. 9 25 pm till 10.45 pm, and at 5 am till 7 am.

VQ7LO—6060kc. 49.50m. Nairobi, Kenya. Heard from 3.30 am till 5.45 am. Good signal on most nights.

Nairobi—10,730kc. 27.96m. Same location. Very good signal in relay of VQ7LO. Also heard at 12.30 am on opening.

TPZ—12,120kc. 24.75m. Algiers, Algeria. Another very interesting one in these days. In French at 8 am and 6.45 pm.

TPZ2—8960kc. 33.48m. Same location. Is being used for contact with USA. Normal service from this one as TPZ.

CNR—8035kc. 37.34m. Rabat, Morocco. Has been taken over by the United Nations. Can be heard at 7 am.

FGA—9410kc. 31.88m. Dakar, Senegal. Similar remarks suit this one, but the time is 6.15 am.

The following readers have reported stations in the above group: Messrs. Condon, Nolan, Johnson, Walker, Gaden, Cushen, Smart, Gillett, Hallett.

AUSTRALIA

VLR—9580kc. 31.32m. Melbourne. National Programme. 6 45 pm till 11.30 pm. Till 11.0 pm Sunday.

VLR3—11,880kc: 25.25m. National Programme. Noon till 6.15 pm daily, 12.50 pm till 6.15 pm Sunday.

VLR8—11,760kc. 25.51m. National Programme. 6.30 am till 10.15 pm daily. 6.45 am till 12.45 pm Sunday.

VLG2—9540kc. 31.45m. To Eastern Asia, 10.25 pm till 11.30 pm. To SE Asia, 2.0 am till 2.45 am. To Western USA, 12.15 am to 12.55 am.

VLG3—11,710kc. 25.62m. To Tahiti, 4.55 pm to 5.40 pm. To Western USA, 1.25 pm till 2.10 pm, and 3.25 pm till 4.10 pm. To Britain, 5.55 pm till 6.25 pm, and to New Guinea in Japanese at from 6.30 pm till 6.45 pm.

VLG6—15,230kc. 19.69m. To SW Pacific from 8.30 pm till 9.0 pm. To Northern Australia at from noon.

VLG7—15,160kc. 19.79m. National Programme. Still on same schedule.

VLG8—17,800kc. 16.85m. Western USA at from 2.0 pm till 2.45 pm.

VLG9—11,900kc. 25.21m. To USA at from 2.0 pm till 2.40 pm.

VLI2—11,870kc. 25.27m. To Britain from 6.0 pm till 6.25 pm and to NE Asia from 8.40 pm till 9.15 pm.

VLI3—15,314kc. 19.59m. To listeners on the China Coast at 9.30 pm. Part of the transmission is in Chinese dialects, and the balance in English.

VLI4—7220kc. 41.55m. To New Caledonia at 6.25 pm till 7.25 pm.

VLI6—9680kc. 30.99m. To Western USA from 12.25 pm till 1.10 pm and from 2.25 pm till 3.10 pm.

VLN3—18,495kc. 16.22m. To USA at 2.0 pm till 2.40 pm.

VLN8—10,257kc. 28.50kc. Discontinued at present.

VLW—9680kc. 30.99m. Perth National Programme 9.0 pm till 11.15 pm.

VLW2—9665kc. 31.04m. To SE Asia from 11.15 pm till 12.55 am.

VLW3—11,830kc. 25.36m. National Programme. 8.0 am till 11.45 am

VLW6—9680kc. 30.99m. To SE Asia from 11.15 pm till 12.55 am.

FK8AA—6130kc. 48.94m. Noumea, New Caledonia. Heard daily from 5.30 pm till 8.0 pm. The latter part of the transmission is in English.

The following readers have reported stations in the above group: Messrs. Condon, Perkins, Larson, Nolan, Thornewhaite, Cushen, Morris, Gunner, Stern, Shiel, Bate, Wass, Lee, Harvey, Gillett, Hallett.

MISCELLANEOUS

OIX—6120kc. 49.02m. Lahti, Finland. Does not seem to be on the air these days.

OIX2—9500kc. 31.58m. Same location. Is on the air from 2.0 am till 10.0 am. News can be heard at 3.45 am.

SHORT WAVES

OIX3—11,870kc. 25.47m. Same location. Same hours as previous station. Also 11.20 am till 5.45 pm. News used to be heard at 2.10 pm.

HAT4—9119kc. 32.90m Budapest, Hungary. Heard from 10.10 am. Fades out shortly after.

HER3—6165kc. 48.66m. Schwarzenberg, Switzerland. Heard early in the morning, French and German only. Best at 6.0 am.

Radio Suisse—15,305kc. 19.60m. Same location. Same service as formerly on this new frequency.

HVJ—5969kc. 50.26m. Vatican City. Transmission to Great Britain at 5.0 am till 6.30 am. Fine signal.

HVJ—11,740kc. 25.55m. Same location. POW session daily at 6.0 pm.

CSW6—11,040kc. 27.17m. Lisbon, Portugal. Heard at good level. Is on the air from 4.0 am till 9.0 am.

CSW7—9740kc. 30.80m. Same location. Heard at 9.15 am till 10.0 am. Fair.

Emissora Nacional—11,090kc. 27.15m. Ponta Delaga, Azores. A new frequency for this one. Neard from 6.0 am till 7.0 am. Usually quite good.

Radio Metropole—9475kc. 31.66m. A regular at 8.0 am. Good signal at times.

Radio Metropole—15,245kc. 19.69m. This outlet is heard at 7.0 am.

Radio Debunk—10,340kc. 29.01m. Mr. Cushen tells us that this one is getting weaker. Is heard at 11.30 am till 12.30 pm in New Zealand.

EAJ22—7140kc. 42.02m. Oviedo, Spain. The only one from this country that we have heard. The time is 7.30 am.

SPW—13,500kc. 22.2m. Warsaw, Poland. This one is reported from Queensland. Has not been heard here for years.

TAP—9465kc. 31.70m. Ankara, Turkey. This one is heard from 12.15 am till 7.0 am.

TAQ—15,195kc. 19.74m. Same location. Has not been reported this month.

Radio Bucharesti—9255kc. 32.41m. Rumania. Heard at good strength from 3.0 am till — am. Best period from 6.0 am till 8.0 am.

SBU—9530kc. 31.46m. Moetala, Sweden. News is read at 8.20 am.

SBP—11,705kc. 25.63m. Same location. Heard best from 5.40 pm till 6.30 pm.

SBT—15,155kc. 19.8m. Same location. A good one at 2.0 am till 3.0 am. Transmission to America.

DXI—6148kc. 48.41m. Oslo, Norway. This one is under Axis control. Heard between 6.30 am and 8.30 am.

DXL15—9590kc. 31.28m. Huizen, Holland. Same applies to this one. Heard at 9.0 pm.

Vichy—9520kc. 31.51m. This one has been heard fairly regularly. The best time is at 4.0 pm.

Vichy—11,845kc. 25.53m. An outlet which is heard at 7.0 pm. Good signal.

Vichy—15,245kc. 19.69m. Heard at any time from 12.30 am till 3.45 am.

Kuibeshev—6115kc. 49.08m. Russia. Has been heard calling CBS and NBC at 11.0 pm.

Kuibeshev—8047kc. 37.28m. News in English at 6.30 am. Also heard at 9.30 pm.

Kuibeshev—9520kc. 31.51m. Also heard calling the American CBS and NBS at 11.0 pm.

Khabarovsk—9566kc. 31.36m. This one is on at 8.45 pm nightly.

Moscow—7625kc. 39.21m. Heard well at 7.0 am and 10.0 pm. Good signal for the most part.

Moscow—12.060kc. 24.88m. Much English is heard from this one at 11.45 pm.

2RO3—9630kc. 31.15m. Rome, Italy. This one is heard all through the day when conditions are good.

2RO4—11,810kc. 25.40m. Same location Good signals at 1.30 am, 6.0 pm and 7.30 pm. English is spoken at all times.

2RO6—15,300kc. 19.61m. Same location. This one is heard relaying 2RO6.

2RO8—17,820kc. 16.84m. Same location. Heard well at 9.0 pm.

2RO9—9670kc. 31.02m. Same location. We are after reports of this one.

2RO10—7220kc. 41.55m. Same location. One of the best of the morning stations at 7.30 am.

2RO17—19,590kc. 15.31m. Same location. Has been heard for months at 10.0 pm.

2RO18—9760kc. 30.74m. Same location. Very good transmission at 10.0 pm.

2RO20—17,820kc. 16.87m. Same location. We have an idea this one is there at 11.0 pm. Very weak.

2RO?—6300kc. 47.60m. Same location. Heard from 3.30 am till 9.15 am. Excellent volume from this one.

2RO?—10,330kc. 29.04m. Same location. Just fair at 8.0 am.

2RO?—9695kc. 30.63m. Same location. Carries a service to Latin America at 9.30 am.

2RO?—11,740kc. 25.55m. Same location. Also on the air from 3.30 am till 7.0 am.

2RO?—11,950kc. 25.10m. Same location. This one is heard in the early morning.

2RO?—15,060kc. 19.92m. Same location. This one is good at 11.0 pm.

DJA—9560kc. 31.38m. Is on schedule from 8.50 am till 3.15 pm.

The following readers have reported stations in the above group: Messrs. Condon, Perkins, Larson, Nolan, Cushen, Gunner, Stern, Shiel, Bate, Wass, Fisher, Lee, Harvey, Smart, Gillett, Nicholson, Norris, Hallett, Miss Sanderson.

THIS MONTH'S RECORDINGS

FIVE AUSTRALIAN SONGS

Australian artists and composers are prominent in the lists of new record releases for this month. The most outstanding of these are, I think, a set of three records made by the well-known Australian bass baritone, Alan Eddy, singing for the first time five songs by Australian composers. By the time these notes are published many of you will, no doubt, have heard these recordings and judged them for yourself.

HOWEVER, to those who have not, I have no hesitation in saying that these compositions have added another milestone to Australian musical history.

"GO DOWN, SUN" (Saunders and Mason), Parts 1 and 2. COLUMBIA DO 2520.

"ALAS, THAT SPRING SHOULD VANISH WITH THE ROSE" (Omar Khayyam and Mason) and "OH, PRAY FOR PEACE" (Taylor and Brahe). COLUMBIA DO 2521.

"THE ROAD THAT LEADS TO NOWHERE" (Saunders) and "PORT O' SYDNEY" (Tainsh and Brash). COLUMBIA DO 2522.

Of these songs, the one that impresses me the most is "GO DOWN, SUN." The words of this number were composed by Hal Saunders, who is considered by many as being one of the most promising of Australian composers.

Saunders has broken entirely new ground in his efforts to convey an Australian atmosphere without having to lean for support on the familiar blue gums, billabongs, wattle, and kookaburras.

Having lived in Australia's outback for many years and experienced the vicissitudes of three severe droughts, Saunders can be said to have given his experiences to the world in words and music. Drought is the theme of "GO DOWN, SUN."

The song tells of one whose cattle is dying, of one who dreams of cool rain and lush grass. But the sun still blazes relentlessly and the man implores it to go down, to spare his stock, to depart from his valley, to let him sleep and dream in his room of grass, of wet hide and hoof.

The composer has interwoven in his song the phrase, "Send Her Down, Hughie." The origin of this is interesting.

Hugh McColl, father of the present Senator McColl, was largely responsible for the first irrigation project on the Murray River. When all was ready, Hugh McColl was given the honor of sending the water into the channels.

The farmers, anxiously waiting for the water, repeatedly used the phrase, "Send her down, Hughie." The saying subsequently caught on and became a byword in that part of the country. Now, when the land is thirsty, the appropriate phrase is, "Send her down, Hughie."

The style of "Go Down, Sun," calls to mind "Glory Road" and "River, Go Away from My Door." Just as these two songs have their place in musical history, so "Go Down, Sun," if properly exploited, must add prestige to our Australian composers.

Mr. Saunders gave me to understand that he has a few more surprises up his sleeve for us, so we can look forward expectantly for these.

Alan Eddy needs no introduction to the Australian public, having toured Australia with the J. C. Williamson Grand Opera Co. in 1931, playing Mephisto in "Faust." He has also been heard on the concert platform and on the broadcasting stations.

Alan Eddy is Australian born and is a cousin of Nelson Eddy. He studied under Jilly in London after a short course under John Brownlee.

He toured London with Brownlee, played Mephisto in "Faust," Collini in "La Boheme," and The King in "Lohengrin." He returned to Australia and was to go back to London with Tauber and appear in "The Magic Flute," but the war prevented this.

He is now marking time in Australia until the war is over, when he intends to return overseas to continue his studies.

Alan Eddy is determined to co-operate with Australian composers to make a name for his native land.

Interviewed, Mr. Eddy gave it as his opinion that it should be possible to give an Australian atmosphere to music without the necessity of words. He thought that an Australian symphony could imitate the hopping of a kangaroo, the call of the lyre bird, &c.

Mr. Eddy shows his enthusiasm in his rendering of "Go Down, Sun." He has captured the atmosphere admirably, and the power of his voice makes me anxious to hear him sing this song with orchestral accompaniment.

This Australian "Glory Road" would certainly lend itself to this.

One should not forget the composer of the music when judging the quality of a song. Miss Mason is another Australian, and her efforts in "Go Down, Sun" and "Alas, That Spring Should Vanish with the Rose" should place her definitely among our prominent composers.

"QUINTET IN C MAJOR"

QUINTET IN C MAJOR, OP. 163 (Schubert), PRO ARTE QUARTET AND ANTHONY PINI (second 'cello): HMV ED160/4, Album No. A23 and leaflet. This quintet by Schubert was written in 1828, the year of the composer's death. It is scored for two violins, one viola and two 'cellos.

The addition of a second 'cello adds to the richness and sonority of the recording and the effective instumentation brings the quintet closer to the orchestral type.

It is not my task or purpose, in these columns, to enter into a discussion as to whether you should or should not like chamber music. That has been a point of issue in almost every record review column that was ever written.

I quite realise that a large number of people lift up their hands in consternation when chamber music is mentioned. However, if many who do so were to play two or three times one of the more melodious works of this character, such as the quintet now under discussion, they would find something restful and soothing, in vivid contrast to the hectic nature of present-day affairs. The first listening is often the least pleasant.

If you are keen to go into it, there are a number of books to be obtained at small cost which explain the form and meaning of chamber music. Armed with good recordings and a better understanding, one should not fail eventually to appreciate this kind of music.

Schubert's state of mind at the time he composed the work is reflected throughout the first movement. His hard struggles are surely symbolised in the C major tonality.

The second theme of the first movement throbs with lovely melody. Then, again, in the Adagio in the key of E Major, the composer presses into service every expedient he could command to give expression to his feelings, syncopation, triplets and passages of unrest.

Somebody has described the Scherzo of this work as "the most terrifying requiem mood in the whole literature of chamber music." Whatever description one gives to this movement, it is certain that Schubert herein recorded the agitation of mind which had beset him.

The Finale is markedly in C Minor key. This is said to signify the apparent hopelessness of the composer's position and can rightly be described as the Finale of Schubert's Chamber Music Swan Song, for this was the last chamber music he composed prior to his death.

On the whole, this work is one of great beauty and the sympathetic and masterly treatment of its performance by the Pro Arte Quartet and Anthony Pini, together with the clear definition of the recording, makes this a notable contribution to the collection of the chamber music enthusiast.

"MATTHIAS THE PAINTER"

"MATTHIAS THE PAINTER" (PAUL HINDEMITH), played by the PHILADELPHIA SYMPHONY ORCHESTRA, conducted by EUGENE ORMANDY, HMV ED165/7.

Perhaps one had better begin by saying that this work is very, very modern. Paul Hindemith asserts that music should be composed with a specific purpose but devoid of any suggestion of emotion, nationalism, sentimentality or of individuality.

He maintains that music should be written for use, much as a carpenter makes a chair. Music, therefore, can be composed merely for educational purposes, for children's games, for mechanical instruments or for accompanying newsreels.

Hindemith's music is based on the chromatic scale, consisting of 12 notes. He does not use chords based on the familiar diatonoc scale, but he assesses the quality of his chords by what is referred to, in the science of acoustics, as the resultant tones; that is, the tones which are generated when two notes are sounded together.

He explains it as "A system of chords built on intervals that subsist from their own individual merit and are not the result of an arbitrary system." No chord must be forbidden if its use seems necessary to the composer; rules are a waste of time.

The result of all this is manifested in this work, "Matthais the Painter."

I simply can't tell you what the music is all about, but this is quite in order, for the composer infers that his music is not about anything in particular, and must be listened to much as one listens to "absolute music"—that is, as much without any attendant mental picture.

It is not my place to say whether this music is good or bad, wrong or right. There seems to be a rising demand for it and, in its own ways, this work is no doubt a valuable contribution. The great fault of the human mind is its reluctance to accept anything new, whether in music, religion or politics, painting or architecture.

Perhaps this modern music is akin to futuristic painting or to modern austere architecture and we may get used to it in time.

For the present, Hindemith's music will appeal to none but kindred souls.

As to the recording, it seems excellent enough, with the various instruments clean and brilliant. If you like this mixture of tonal and atonal music, I don't think you will be disappointed with the three discs which this work occupies.

TWELVE CONTRA-DANCES

"TWELVE CONTRA-DANCES" (Beethoven). COLUMBIA BROADCASTING SYMPHONY. COLUMBIA DOX 2511/2.

It is not entirely easy to couple the name of Beethoven with these dances, as they are by no means written in the style which has made the name of Beethoven famous.

These Contra Dances are not very well known. As the name implies, they are written for dances where the dancers line up facing one another before the Minuet or Polka begins.

The twelve dances were composed about 1802 and are written in the keys of C, A, D, B flat, E flat, C, E flat, C, A, C, G, E flat, respectively.

Number 7 was used in the Finale of Prometheus, Eroica, &c. Number II was also used in the Finale of Prometheus.

These dances are very gay and will make you want to jig. They tend to be rather monotonous however if both records are played right through wtihout interruption.

There are four sides of two ten-inch discs. The recordings are very good, the violins being particularly brilliant. I like sides three and four the better of the two records.

★ ★ ★

"NEW VIENNA WALTZ" (Strauss), played by the BOSTON PROMENADE ORCHESTRA. HMV EA 2971.

A typical Johann Strauss waltz, nicely played on two sides of a 10-inch disc.

"A NIGHT ON A BARE MOUNTAIN" (Moussorgsky), played by the PHILADELPHIA ORCHESTRA—Conductor: Stokowski. HMV ED168.

Here is a piece of music composed to appeal to the imagination of those with limited musical education. The following remarks appear on the score. "Subterranean sounds of unearthly voices." "Appearance of the spirits of darkness followed by that of the god Chernobog, the Black god of Mount Triglaf." "Chernobog's glorification and the Black Mass." "The revels." "At the height of the orgies is heard from afar the bell of a little church which causes the spirits of darkness to disperse." "Dawn."

So arm yourself with this description, turn out the lights and, if you are unable to reconstruct the above supernatural goings on, your imagination is sadly at fault.

The "Dawn" scene, after the tinkling of the little bell on part 2, has a melody of great beautv. The recording is excellent, but here a word of warning. In parts, the amplitude is so great that it is likely that the record will not have a long life. I could not play it with a fibre needle, as the point wore out too quickly. A very fine pointed steel needle of the soft tone variety will be the kindest way to treat this record.

VOCAL RECORDS

JOAN HAMMOND, soprano, accompanied by the Halle Orchestra. "MARRIAGE OF FIGARO" (Mozart) Recit: "Still Susanna Delays" and Aria: "Whither Vanished" (sung in English). COLUMBIA DOX 691.

This is the first record of Joan Hammond singing a Mozart work. I can really go into raptures when I listen to this singer. Comparable control and expression is rarely heard. The orchestral accompaniment accents the power of Joan Hammond's voice and a very unusual echo in the hall in which the recording is made adds life and realism to the whole work.

If you are an admirer of Joan Hammond, you will love her all the more after hearing this record.

* * *

EZIO PINZA, bass, "Caro Mio Ben" and "Bellissimi Capelli" on one side and "Lungi Dal Car O Bene" with "Pupille Nere" on side two. HMV ED172.

I always feel that these large-voiced bassos do not sing at their best unless they are assisted by an orchestral accompaniment. In this record the piano seems to make Pinza somewhat subdued.

However, he certainly commands attention with that unusual "throaty" voice and sings well, specially in "Caro Mio Ben."

* * *

WEBSTER BOOTH, tenor, "The Lord's Prayer" (Malotte) and "When Big Ben Chimes." HMV EA2973.

This is the first tenor recording of the famous "Lord's Prayer" and one which you should hear. Webster Booth has an organ and piano accompaniment which adds greatly to his fine singing.

There is quite a difference in the rendering of this composition between Webster Booth and John Charles Thomas.

If you want to hear it sung as a prayer, one must choose John Charles Thomas. Booth sings it in more a lyrical style but it is thrilling nevertheless.

The reverse side of the disc has a song which is more commonplace. It is, perhaps, typical but I feel that Booth could have chosen something better than "When Big Ben Chimes."

* * *

DAVID LLOYD, tenor, accompanied by WELSH GUARDS BAND. "Bread of Heaven," with male voice trio, and "Over the Stone." COLUMBIA DO 2518.

I was pleased with this record. David Lloyd has a pleasing voice, rich and clear. The Welsh Guards Band records extremely well, with the basses giving that fullness so much desired in a band recording.

Both sides are worth having and I don't think you will regret it if you purchase this record.

* * *

POPULAR RELEASES

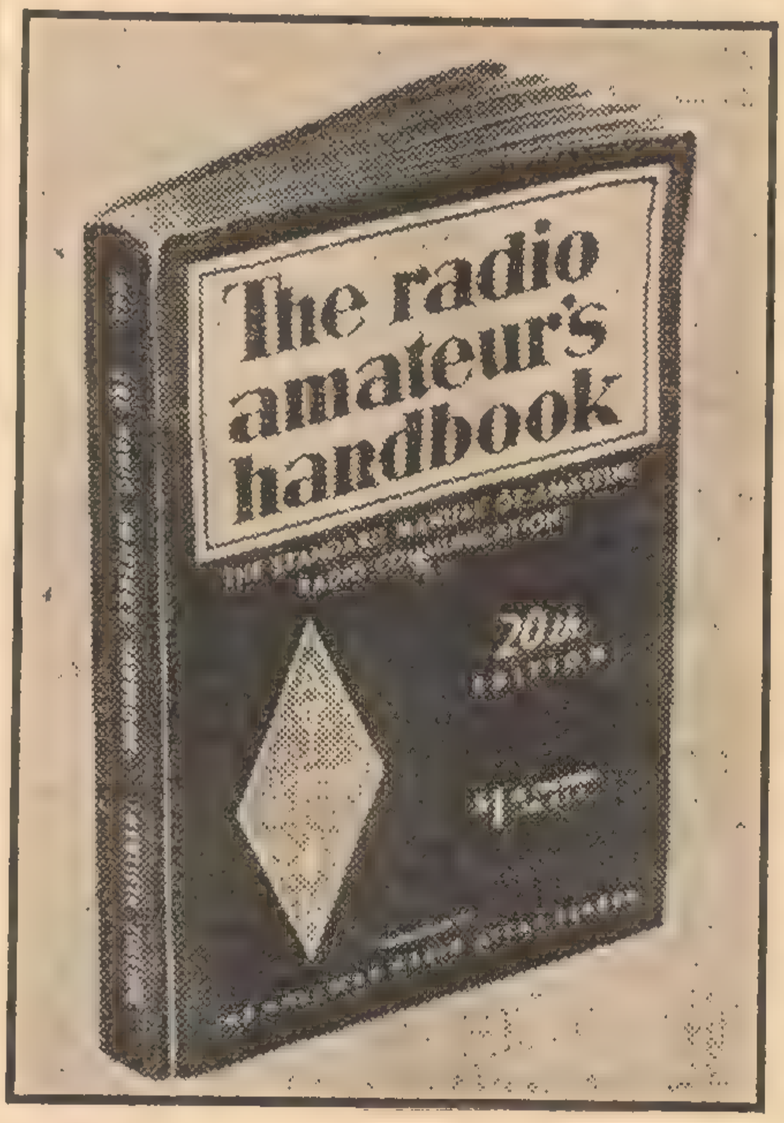
COLUMBIA: VICTOR SILVESTER AND HIS BALLROOM ORCHESTRA—"Miss You," quickstep, and "On the Street of Regret," waltz. FB 2523.

HIS MASTER'S VOICE: ARTIE SHAW and GRAMERCY FIVE—"Cross Your Heart" and "Summit Ridge Drive." EA 2974.

DECCA: FLANAGAN AND ALLEN—"Cornsilk" and "What More Can I Say?". Y5750 BING CROSBY with WOODY HERMAN'S WOODCHOPPERS—"I ain't Got Nobody and Nobody Cares for Me" and "You are My Sunshine." X2051. VERA LYNN appeals again in "The Anniversary Waltz" and "Little Curly Hair in the High Chair." X2081.

RADIO TRADE NOTES

A.R.R.L. HANDBOOK FOR 1943



We have recently received through the post a copy of the 1943 edition of the Radio Amateur's Handbook. Published by the American Radio Relay League, this is the 20th edition of this well-known manual.

Besides being the twentieth edition, which is somewhat of a milestone, the publishers state this to be the largest to date. The main body of the technical matter occupies some 480 pages. The comprehensive index occupies nine pages and the specially illustrated trade components section 100 pages.

Although conforming to the general presentation adopted for preceding ARRL Handbooks, the present edition has been compiled with due regard to the requirements of a wartime manual.

Chapter 1 is introductory. Chapter 2 deals in concise fashion with radio fundamentals. Chapters 3 to 10 inclusive are devoted to a discussion of the principles and design of radio apparatus. The subject matter covered includes vacuum tubes, radio frequency power generation, keying and radio-telephony. There are chapters on wave propagation, on antenna system, and on receiver design.

Treatment is quite sound and, for the most part, non-mathematical in character. The discussion is sectionalised to facilitate study and a system of cross-indexing allows discussion elsewhere to be traced relative to a particular point.

CONSTRUCTIONAL ASPECT

The next ten chapters cover the constructional aspect of radio equipment. Separate sections deal with receivers and transmitters for the usual high frequency bands and for what have come to be known as the Ultra-high Frequencies. Also included are chapters on measurements and measuring equipment, on tube data and characteristics, and workshop practice.

In regard to the constructional data, much of the apparatus is of quite a simple nature, although there is also quite an amount of elaborate equipment.

Mention is made of micro-wave oscillators, a subject which will almost certainly be very much in the news after the war, when the secrets of some of the amazing radio gear now used by the Forces becomes public property.

One section, which is intended particularly for American amateurs, is that dealing with the WERS—the War Emergency Radio Service. The publishers describe this as a "complete WERS manual."

For the radio enthusiast with a limited amount of capital this Handbook represents good buying even at the Australian price, which includes certain loadings. While it is intended particularly for those with a leaning to amateur radio, there is a tremendous amount which will interest other technical readers.

Stocks of the new ARRL Handbook have arrived in Australia. The price is approximately 11s, and cost of postage within the Commonwealth 1s.

F.M. SURVEY IN U.S.A.

In an effort to learn what the US listening public thinks of frequency-modulated broadcasting, General Electric engaged an independent research organisation to make a survey in New York City, Chicago, Detroit, Philadelphia, Albany, Worcester, Milwaukee, Pittsburgh, Columbus, Nashville, Los Angeles, Baltimore, Indianapolis, and St. Louis.

The fact that the study was being made for a manufacturer of FM receivers was not mentioned during the hundreds of interviews. Names of FM set-owners were obtained from dealers in each of the 14 cities covered.

Results of the survey follow:—

79 per cent. of those interviewed are satisfied with the FM quality of reception.

85 per cent. believe FM quality a decided improvement over regular broadcasts.

75 per cent. tune in on FM stations more than once a week, over 50 per cent. listen to FM at least once a day.

91 per cent. would recommend a set equipped with FM to their friends.

45 per cent. believe that "improved tone quality" is the one FM advantage more important to them; 41 per cent. think "freedom from noise and static" is the most important advantage.

79 per cent. said "Yes" to the question, "Have any of your friends listened to FM on your radio?"

90 per cent. said their friends' opinions of FM radio are "favorable."

BUILD A MODERN OCCASIONAL TABLE

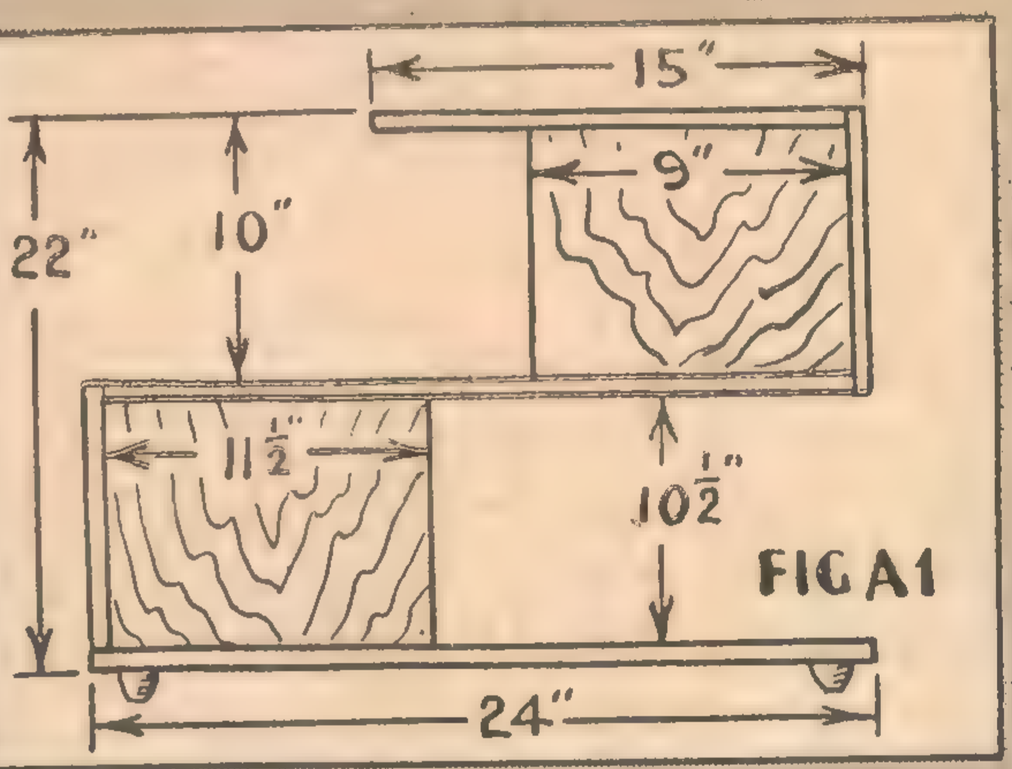


FIG A1

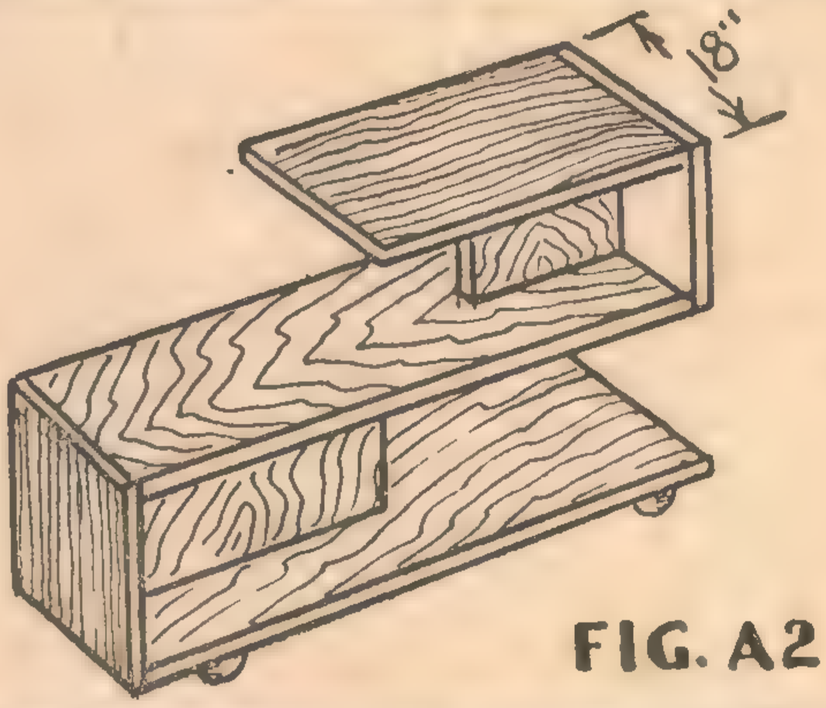


FIG. A2

FIG B1

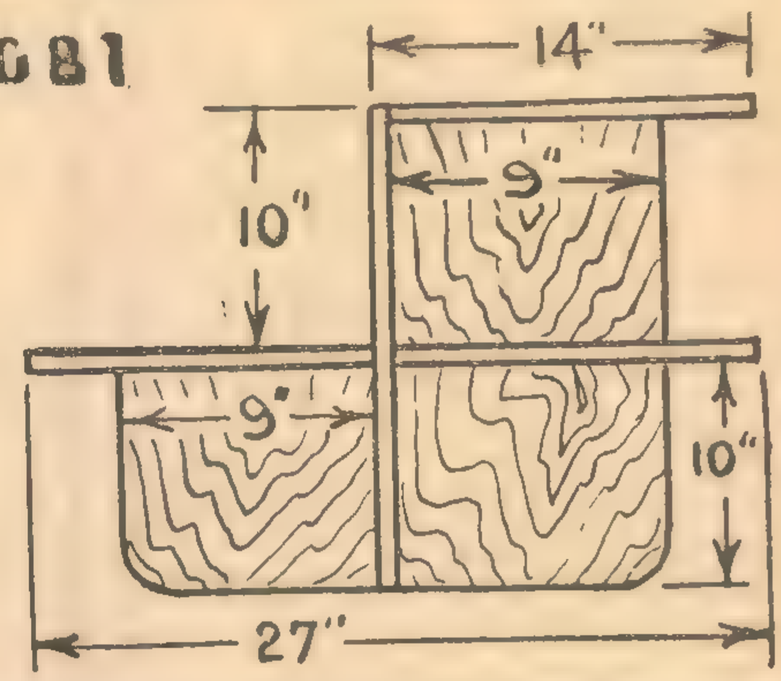
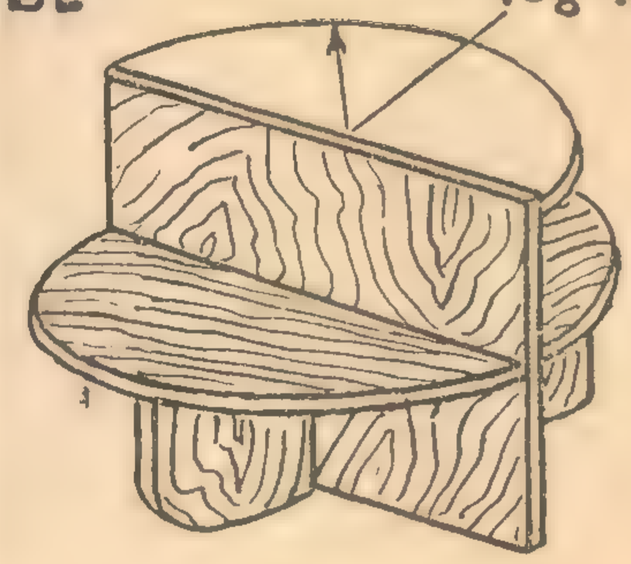


FIG B2



In almost any home one can find plenty of use for a small occasional table, especially if it is of unconventional design and one with plenty of space to stand things on. The handyman who can build such small items of furniture for himself is in a particularly happy position in these days when the range offering is so small.

THESE two modern tables can be used for books and magazines or any other items. Being attractive and simple, they provide no difficult problems to the builder. When completed, you will find them very useful additions to the home.

The material for both designs should be ¾in. thick and well seasoned, so as to eliminate any possibility of warping after completion.

For the "A" type table, details of which are given in Figures A1 and A2, cut one piece of stock 5in. long x 18in. wide for the top, one piece 22½in. x 18in. for the centre, and one piece 24in. x 18in. for the base. The top centre piece is 9in. x 9¼in., and the bottom centre piece is 10½in. x 11½in.

Figure A2 is not drawn to scale, but rather to show the manner in which the various pieces are assembled. The simplest method is by means of 2in. wood screws with countersunk heads. Make sure that the head of the screw is well below the surface of the wood when driven home. The holes may then be filled with plastic wood and sanded till flush.

If you have the tools and the experience, a tongued-mitre joint can be used instead of the screws, but, if used, be sure to stop the spline an inch from each edge.

by
W. G. Nichols

For the "B" type table (see Figures B1 and B2), three half circles of wood are required. Each has a radius of 13 1-8in., and the central upright piece measures 26¼in. long x 20¾in. wide. The two lower centre pieces are 9in. x 10in. and have their bottom outside edges rounded. The upper centre piece measures 9in. x 9¼in., and the four corners are left square.

The method of construction is similar to the "A" type table, with the exception that the two lower half circles and the two lower centre pieces are held in place by 3in. lengths of 3-8in. dowels, which pass through holes in the upright piece and into each of the half circles and centre piece. The dowels should be given a coat of glue before pressing home.

FINISHING TOUCHES

Sand the tables well before finishing off with a fine grade paper. If they are for use in a sun-room, cheaper timber can be used and they can be finished with duco or enamel paint. Sand each coat down with fine grade paper before applying the next coat. About three coats are needed to give a good finish.

If figured timber is used, the table can be polished in a shade to match the other furniture in the room.

JOE'S COLUMN

Let's talk about rubber. Its scarcity is common knowledge and the Allied Nations are out to make their rubber stretch as far as possible. Military demands are enormous, which means that most rubber articles we are using in the home at present will be irreplaceable when they wear out. That means only one thing—you must take care NOW of the rubber articles you are lucky enough to possess.

Perhaps the greatest enemies of rubber are grease and oil. If left on rubber for any length of time, it soon begins to deteriorate. Even if you have only walked across the garage floor, whilst wearing rubber shoes, scrub the grease off with soap and water, trisodium phosphate or a solvent such as acetone. Be sure to remove all traces of the soap or phosphate with water. This method can safely be used for any rubber article.

Store your rubber shoes in a cool, dry, DARK place. If you have no such spot, wrap them in paper and store them away in a natural position, not folded or crushed. The same applies when carrying rubber shoes in your car. Don't walk them over sharp cinders or broken glass, and remember that rubber cuts more easily when wet.

Thousands of feet of rubber garden hose are destroyed by sun and heat. Roll your hose up and store it in a dark shed or basement. If it is rolled on to a reel attached to the house, a light-tight cover having the sides and fronts hinged should be built around it.

Don't let the water remain in the garden hose. Some people will tell you that water will not affect it, but if left in for extended periods it will gradually penetrate the rubber, spread through the fabric and cause mildewing and rotting. Drain the hose by progressively arching it upward.

Another common cause of damage to all types of hose is sharp bending, such as that caused by kinking, hanging the hose on a nail or squeezing it double to shut off the flow of water through it. Its life is also shortened if you walk on it or run over it with the car.

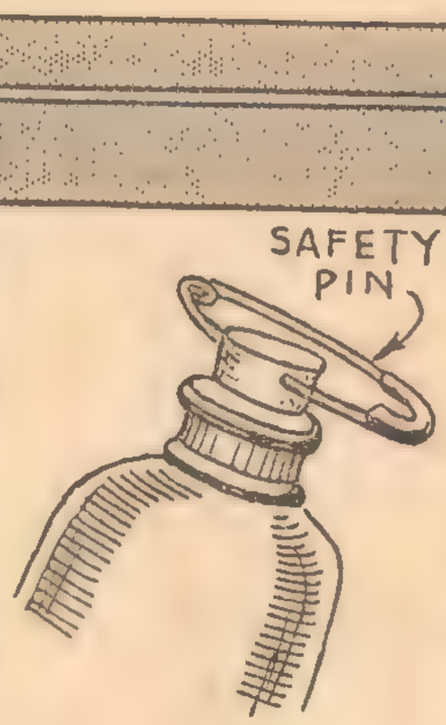
Cords used on electrical appliances contain rubber. Keep the kinks out of them. See that your wife or mother doesn't wind the vacuum cleaner cord too tightly round the two hooks on the handle.

To take care of all rubber articles, remember the following: Keep grease and oil away from them, keep them away from light and heat, avoid distorting and putting them under any undue stress.

By the use of a Polarograph, which ads the amount of electric current ssing through a solution, scientists are w able to measure the amount of rious substances the solution contains billionths of an ounce. The microalysis may be performed in minutes, inst the older techniques which took rs.

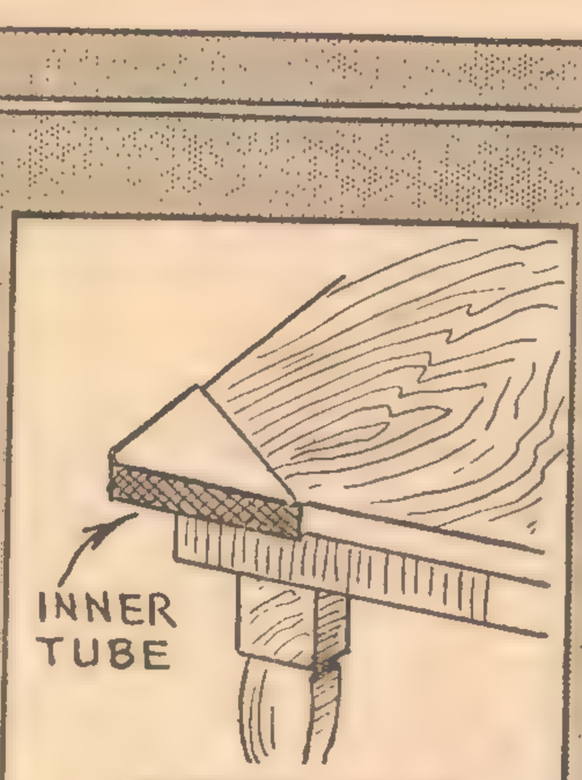
HINTS FOR THE HOME HANDYMAN

By W. G. NICHOLLS



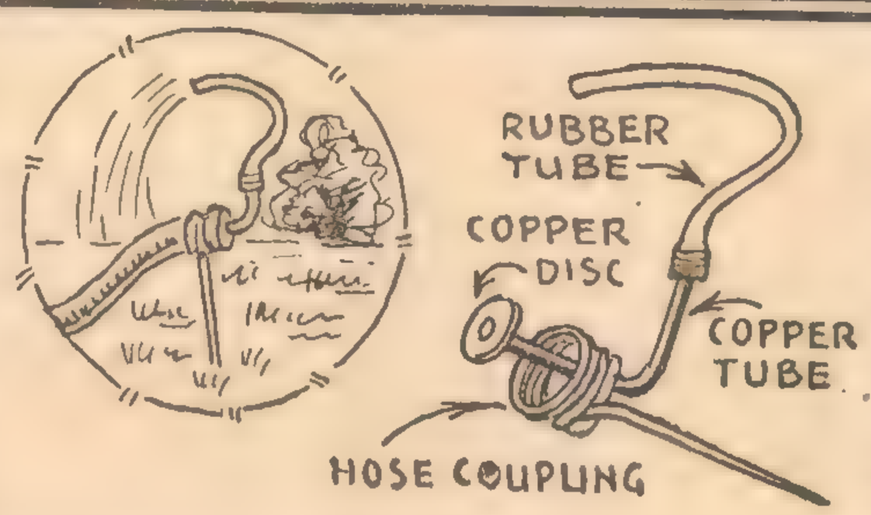
CORK STOPPER

A safety pin inserted in a cork will prevent it being pushed down the neck of a bottle which is used frequently.



CORNER PADS

Small pads made from triangular pieces of rubber inner tubing sewn or cemented together will prevent children hurting themselves on sharp corners of tables.

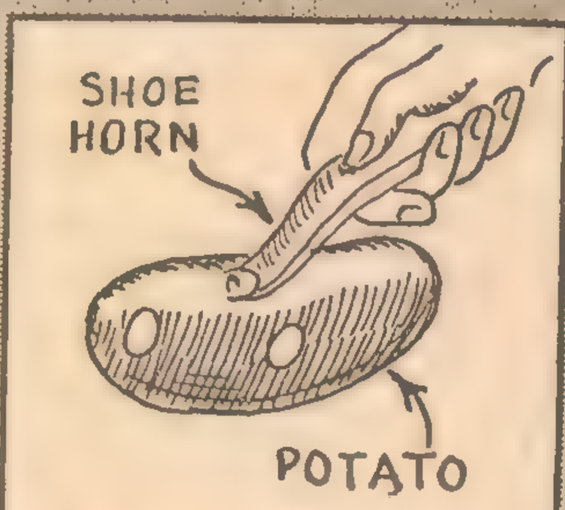


GARDEN SPRINKLER

A copper disc is cut to fit the hose coupling, and a 1/4in. hole drilled through the centre. A short length of 1/4in. copper tubing is soldered to it, and bent at right angles. Then the disc is fitted to the hose coupling, a 12in. length of rubber tubing fastened to the copper tube; a wire spike, bent around the coupling, will hold the completed sprinkler in position.

SHOE SHIELD

Before starting to clean white shoes, place each shoe on thick cardboard. Mark round the edge of each with a pencil, and cut the cardboard about 3-8in. inside the pencilled line. The shield will then fit snugly between the welt and upper, and the shoe may be cleaned without polish being smeared on the sole.



POTATO HINT

Potatoes may be grown successfully if only the eyes are planted. The eyes are removed with a shoe horn as shown, and the remainder used in the kitchen.

ANSWERS TO CORRESPONDENTS

UNDER THE PERSONAL SUPERVISION OF THE TECHNICAL EDITOR

QUERY SERVICES

ORDINARY technical queries will be answered on this page in strict rotation. Readers who desire an answer by mail should enclose a postal note or stamps to the value of one shilling. We are short of staff, but we will do our best to answer as promptly as possible. Make your letters clear and to the point and do not ask us to draw out special circuits, as this is quite impossible at the moment.

F.W. (Elwood, Vic.) relates his experiences with a large receiver he has constructed.

A.: The 13-watt amplifier is not so critical as to require the use of resistors and condensers having less than the usual tolerance of values. However, no amplifier will operate properly if the condensers are intermittent or leaky. Anyhow, glad to know that it is now performing so well. A three-valve superhet. tuner is scarcely the best choice where the primary consideration is quality, because its selectivity reduces the high frequency response. You seem to have been very unfortunate in the coil kit which you purchased. Certainly the ordinary kits are less elaborate than those used in high-grade American receivers, but they should—and usually do—perform much better than you infer. Have a look at the tuner in the "TRF Quality Six" receiver described in "R. and H." for May, 1942; it should be just the thing for you. A magic eye could be added, if necessary.

Thanks for the kind remarks and the suggestions. The kink is quite a good one and has been set aside for future use.

W.J.F. (Ingham, Qld.) asks several questions.

A.: Thanks for the encouraging remarks and suggestions. We are pleased that you liked the battery-operated amplifier; a vibrator version would certainly be the goods, but vibrators are practically unobtainable at present. For the same reason, a vibrator-operated short-wave set is scarcely a proposition at the moment. A Communications receiver is one which has been designed especially with a view to the reception of distant signals. Compared to an ordinary receiver, it may have a more elaborate tuner and more controls. However, the term is quite a broad one. A regenerative receiver is one in which regeneration or reaction is used, usually with the idea of increasing gain. A permag. extension speaker can often be connected directly in parallel with the input transformer of the existing one, without further complication. Power is then shared between the two speakers. Theoretically, the parallel connection causes some mismatch but this is usually unimportant in practice.

J.S. (Clifton Gardens, NSW) is building a short-wave battery set and requires the coil data to cover from 10-70 metres in three bands. Tuning condenser is a .0001 midget, coil formers are 1in. diameter, and wire 22 gauge SCE.

A.: We can only give you a rough idea of the number of turns to use on each winding. You will then have to adjust the coils as best you can by cut and try methods. See the page of coil data in "R. and H." for July, 1942, and January, 1943. The coil for 10-20 metres would have to have about seven turns on the grid winding, spaced to occupy ½in.; reaction about seven turns and aerial winding 2½ turns interwound. For 20-37 metres, the grid winding would require about 12 turns, spaced to occupy ½in.; reaction about the same number and the aerial winding, just clear of the earthed end, about six turns. For the last coil the grid winding would require about 29 turns, close wound, reaction about 20 and aerial about 10 turns. You would require some finer wire for all reaction and aerial windings —say, about 32 gauge enamel.

C.C. (Wollstonecraft, NSW) reports that he has built up a dual-wave version of the "42/43 Standard" and is entirely satisfied with the results.

A.: Pleased to note your success with this circuit. Your wiring of the heaters is quite in order. It is a good idea to use a 600-volt bypass on the B-plus line rather than a 400-volt type, although most people seem to get away with the latter quite OK. Yes, semi-dry electrolytics have their disadvantages, but there are no alternatives these days. The torch globe fuse idea is quite a good one. There should be no need to modify the value of the back-bias resistor.

R.M. (Bexley, NSW) reports that he has had pleasing results with the "Little Jim's Mate" receiver.

A.: Glad to receive your note, R.M., and hope that all your sets turn out as well as this one.

J.E.F. (Mount Isa, Qld.) sends in the circuit of a small receiver which is giving a lot of trouble.

A.: It would appear that the trouble is due to audio instability. Try bypassing the "cold" side of the RF choke to earth with a .00025 mfd. condenser. Also try decoupling the plate feed of the detector; instead of returning the 0.1 meg. resistor from the plate of the detector to the 90-volt tapping, couple it in series with another resistor of, say, 50,000 ohms and return it to plus 135 volts. Bypass the junction of the two resistors to earth with a condenser of at least 0.25 mfd.; the higher this capacitance, the better. With a good R-F stage ahead of it, this receiver should give headphone reception of the stronger short-wave stations.

L.V.C. (East Malvern, Vic.) has built the "Luxury Amplifier" and votes it a great job. In his opinion, the 6V6-G valves with feedback are better than push-pull 2A3's.

A.: Glad to note your success with this amplifier, L.V.C. Your letter made quite interesting reading. There is much diversity of opinion re the 6V6G's with feedback and the 2A3's. Opinions aside, a check-up on lab. instruments shows that there is little to choose between them under the ordinary conditions in which both are operated. We note your interest in the more advanced type of article, but, as you say, we have to try and cater for everybody.

T.W. (Bellevue Hill, NSW) has built up several small receivers and is now anxious to try out the "Communications Four."

A.: As regards the values of the two potentiometers, the circuit is correct. Many of the parts used in this receiver are now hard to obtain, but you may be able to pick up suitable or substitute parts by trying at the various radio stores. We doubt whether any one store would be able to supply the complete kit.

P.J.G. (Geelong, Vic.) sends in a subscription and makes a few suggestions.

A.: Thanks for your sub., P.J.G., and for the various suggestions. The DX and short-wave pages are compiled along lines which our letters indicate to be generally favored. Articles on Television, &c., would be interesting enough, but would have to be included at the expense of something else. They might serve a better purpose later on, when the end of hostilities is clearly in sight.

R.S.B. (Cleveland) sends in a circuit for approval.

A.: The circuit appears to be OK except for the detector. You show regeneration in the cathode circuit, but no method of controlling it. Usual scheme is to vary the screen voltage; this could be done quite easily in your circuit by making the .05 meg. resistor in the screen circuit a potentiometer. The "Radiotron Designers' Handbook" should be available by now at all booksellers. As we announced in the February issue, a further 5000 copies have been printed.

K.J.B. (West Croydon, SA) has built up the "Little General" receiver, using a variety of substitute parts.

A.: The EK2 converter requires only 50 volts on the screen. Supply the screen of the I-F amplifier through a 60,000 ohm series resistor from B-plus and feed the screen of the EK2 from that of the I-F amplifier through another 60,000 ohm resistor, bypassing each screen with a 0.1 mfd. condenser. Use of the EL3 type power valve would necessitate reducing the back-bias resistor to about 200 ohms. The 395-volt power transformer would deliver excessive output voltage. The best way to drop this would be to connect a heavy duty resistor of, say, 1000 ohms in the B-plus line between the filament of the rectifier and the junction of the field coil and the first filter condenser.

T.B.R. (Warracknabeal, Vic.) suggests that we should run a circuit now and again for a receiver or amplifier to operate from 32v. lighting sets.

A.: Thanks for your sub., which has been duly recorded. In order to take full advantage of the 32v. plant, it would be necessary to have a 32v. vibrator or genemotor to provide the high tension voltages. Unfortunately, such items are unobtainable at the moment. We will keep your request in mind for better times.

A.F.F. (Ridgewood, NSW) sends in a subscription and makes some suggestions.

A.—Thanks for the subscription, A.F.F., and for your interest in R & H. Glad you appreciated the Model Train article; we cannot see our way clear to devote more space to hobbies at the moment. Glad you like "How It Works."

D.H.I. (Brisbane) is interested in DX and wants to add to his one valver.

A.—With regard to the DX, we suggest that you drop a line to Roy Hallett, at 36 Baker-street, Enfield, NSW. If you want to add to your receiver, get hold of a copy of "Radio and Hobbies" for July, 1942. It should meet your requirements exactly.

L.H. (Burwood, NSW) wants the circuit of a simple a-c operated modulated oscillator.

A.: The circuit you refer to was published in the August, 1941, issue of R & H. Copies of this particular issue are still available from this office. Price of all back numbers is 6d. plus 1d per month out of date. Postage is free.

J.T. (Oakleigh, Vic.) sends in the circuit of a "Super Reinartz" receiver, from which he claims to obtain surprising results.

A.: Thanks for your letter, J.T., and for the circuit enclosed. We intend to look into the possibilities of this type of circuit in the near future.

G.M. (Warragul, Vic.) sends in the circuit of a one-valve receiver which he is using to good advantage.

A.: Thanks, G.M., for your letter and for the circuit. Actually, it is not altogether novel and was one of the many schemes tried out in the search for smoother reaction.

A.G.S. (Norwood, SA) sends in an interesting letter describing a super "Majestic Radiogram" which he has built up.

A.: Thanks for the letter and photo and also for the encouraging remarks in regard to R & H. The receiver must indeed be a fine job. We hope that the additional T.R.F. tuner turns out a success.

L.T. (Concord West, NSW) says that his receiver now fails to bring in 2FC and 2BL although stations on the other end of the band come in.

A.: It sounds very much like a faulty converter valve and a replacement may clear up the trouble. However, there may be something amiss in the circuit, in which case your best plan would be to call in a serviceman. We assume that the receiver is a superhet, although you do not specifically say so.

D.S. (Parkville, Vic.) suggests that we should describe a battery-operated modulated oscillator.

A.: Thanks, D.S., for the suggestion. We cannot promise anything at the moment, but we will keep it in mind.

A.D.C. (Caulfield, Vic.) asks some questions out a receiver he is building.
A.: With due consideration to the conditions der which the various valves operate, total rrent drain would be abou. 65 milliamps— rtainly too high for a 60 milliamp transrmer. You could reduce it by using a 600 m bias resistor on the output valve Dropng resistor for the 6L7 screen would be ,000 ohms and for the 6D6 screen about ,000 ohms. If the 6F7 triode is resistance upled, you will not have to provide for y voltage drop in addition to that occurring turally across the plate load resistor. We ve never tried the particular regeneration neme in practice, although it should work properly adjusted. In fact, proper adjustnt is essential to any regeneration circuit.
G.S. (West Ryde, NSW) complains of the ere interference caused by a powerful local tion.
A.: The fact that you have tried several eivers with no success appears to exonerate ur receiver from blame. Try a short but icient outdoor aerial with a wave trap in ies with the lead-in, tuned to the offending tion. Earth the receiver to a good earth tallation, having no connection to the water ins. If possible, connect a line filter close the receiver in series with the power lead. thing the case of the filter. These measures ould help matters. A crystal set would be retty hopeless proposition in your location.
F.F. (Leichhardt, NSW) asks about the maths icles in R & H.
A.: No, F.F., there is no complete volume taining these maths articles. They are tten month by month exclusively for "Radio d Hobbies." If you are anxious to revise r elementary arithmetic, call in to Angus d Robertson, or some other book seller, d buy an arithmetic textbook of the type d for school use. We published an article a multimeter in the July, 1939, issue.
.B. (Kadina, SA) has an a-c receiver which very noisy on occasions.
.: From the behavior of the set, we would that the trouble is most likely due to aulty valve. However, there are a host of er possibilities and the best thing would to let the local serviceman have a look at To drop the voltage for a 30 from 3.0 s to 2.0 volts, a resistor of 16.7 ohms ld be required. Thanks for the encouragremarks.
.S.K. has built up the "Jeep" five-valver votes it as one of the finest simple reers he has ever come across.
.: Thanks, C.S.K., for the report. We glad to see that the receiver turned out well.
E.S. (Carlton, Vic.) is puzzled as to the ect method of reading the scale of an meter.
: As your scale is marked from 0-500M., ling from right to left, it can be assumed it is calibrated for the conventional series meter circuit. These scales are marked in terms of so many thousands of ohms. scale deflection means zero resistance een the test prods—that is, a dead short. first major division is 1000 ohms, the next and so on, up to 500,000 ohms, or 0.5 meg. e a few thousand ohms, the scale becomes ped and cannot be read with any great ee of accuracy.
H.R. suggests that we should publish some les on the vacuum tube voltmeter and ses.
Thanks for the suggestion, N.H.R., and hope to oblige during the year. In the time, there is an excellent chapter on the ct in the "Radiotron Designer's Hand-"

SHORT-WAVE REPORTS

N. Gunner (Stanmore, NSW): Pleased to hear rom you and hope that you will be able to end in regular logs again. Will be glad to near of any replies you receive to the reports sent out.

M. Morris (Merewether, NSW): Thanks for the telegram and letter. Will return letter you sent me. Thanks also for the details. Will use them soon.

A. T. Cushen (Invercargill, NZ): Always glad to hear from you. Hope conditions are holding up over there. They seem to be good. Keep up the good work. All the best.

J. Thornewhaite (Drummoyne, NSW): As regards the stations mentioned, I cannot give any information about them. Special tests are in progress. The frequency was correct.

A. T. Johnson (Maylands, WA): Report received in good order. Please state the time you observe in your reports.

J. Teare (Oakleigh, Vic.): Thanks very much for the details you sent, but would like details of the stations you have heard and cards received.

R. Nolan (West Perth, WA): The excellent log is very welcome. An insight into reception over there, such as you give, is very handy.

E. Larsons (Footscray, Vic.): You get very fine results on the one-valver. Keep at it and you will find it very interesting. Good luck.

J. W. Swingle (Hawthorne, Q): Am writing to you soon. In the meantime I hope that you get the best on your new receiver. See page 29 in the February issue. Best wishes.

R. G. Nichols (Berri, SA): You have had a similar experience to that of many people. We cannot explain it at all. Hope you get your reports.

H. Perkins (Malanda, Q): Glad to hear you are doing so well. Pleased to hear that the result of the storm was not very serious. Hope to receive a good log next month. Best wishes.

A. Condon (Laura, SA): Some very interesting dope this month. We are looking for the station on 25.52m. Hope that it is TJF. Will let you know if we are successful.

L. Walker (Applecross, WA): Congratulations on your success. The log is very interesting, especially the news of TFJ. We hope to hear them here soon. Regards.

B. Stern (Bondi, NSW): Very glad to receive your log. Reception seems to be good in your district. Pleased to hear you heard the NZ station. Hope that you have sent your report.

J. Sheil (Melbourne, Vic.): Will be pleased to hear that your interference has cleared up. Good luck.

J. A. Bate (Merriwa, NSW): You are doing well. Keep it up and you will be turning in a very fine log. Hope that the set keeps up to standard for you.

A. H. Wass (Wagga, NSW): Very glad to hear from you again. Hope that you get your set down there. Regards.

B. M. Walker (Linwood, NZ): You seem to be well ahead in receiving your card from KWID. Hope that you get the reply for the other transmission.

Dr. K. B. Gaden (Quilpie, Q): Very pleased to get your issue this month. Will be pleased to see the photos. Reception up your way seems good as usual. Hope that you get more time next month. Best wishes.

R. Fisher (Caulfield, Vic.): Glad to see that you like the book. Hope that you will be able to send in reports in future.

A. Lee (Merewether, NSW): Will look around and see if we can find any parts for you. There must be some still around.

W. Harvey (Dubbo, NSW): Pleased to hear that the receiver is going well and to see that you are getting results.

G. Smart (South Caulfield, Vic.): Had given you up for lost, but very glad to hear from you. Hope that you will keep among the stations.

R. Gillett (Dudley Park, SA): Under the circumstances, you are doing well. Will write to you soon. Regards.

K. P. Nicholson (Glen Iris, Vic.): Keep at it and you will achieve even better results than you are now getting. The set you are using can give remarkable results. The only way you can improve it is to add an RF stoge.

Miss D. Sanderson (Malvern, Vic.): Your log is as usual very good. Glad to see that you are getting the veri's. Thanks for the remarks.

R. Hallett (Enfield, NSW): Thanks for the log, we will get into touch with you. Best wishes.

E. C. Jamieson (South Yarra, Vic.): We are glad to rewelcome you to our pages, and hope that you will continue to send in logs for some time to come. Pleased to read that you are getting such good results. Regards.

J. D. Harrington (Cremorne, NSW): Thanks for the remarks. You will see that the matters are fixed up. They were too late for last issue.

L. H. Poynter (Melbourne, Vic.): Hope that the time factor does not creep into your activities in the future. Suggest you try for some of the more unusual ones All the best.

* * *

To those readers who have written letters asking for the details of Mr. Gillett's aerial system. We will post this information as promised as soon as the information reaches us.

Broadcast DX

A. G. Condon (Laura, SA): Many thanks for that welcome snap of yourself; I am always pleased to receive snaps of our readers. Shall be glad to let you have those addresses.

D. Berndt (Wootha, Qld.): Wish I had been with you when KFBK was R9 on the occasion you mention. You should hear some fine signals from Asia when the winter season begins. Thanks so much for that KXEL letter.

L. Smith (Glenn Aplin, Qld.): Glad indeed that you at last decided to write us a note. It is very pleasing to learn that you enjoy our page, and found the Australian list of interest. My first QSL was from SW station DJB, Berlin, received in 1938. You certainly have a fine collection.

L. Gliddon (Upwey, Vic.): Pleased to hear that those verifications are still arriving at your QRA. They are few and far between here these days. Hope the radio course is still going along smoothly. Static hasn't been so bad here of late, and I have had a few good nights' DX'ing.

Dr. Gaden (Quilpie, Qld): Glad you have managed to log WQXR; it should be good during the winter months. Daylight reception is coming in here on short waves now. Europeans were heard on the 25 this week at 2 pm.

R. J. Brock (Maroubra, NSW): I shall be very pleased to let you have some information about reporting stations by mail. Glad to know you like our page, and that you think DX would be a very interesting hobby; believe me, it certainly is.

WANTED TO BUY, SELL OR EXCHANGE

WANTED to buy: Copy of R. and H, May, 1940. Or detail construction of electric guitar (individual coil). **G. E. Day, 1116 Lydiard-street, Ballarat.**

WANTED: Model 0 gauge, rail and chairs. What have you? Particularly by letter. **L. H. Donnell, 22 Mitford-street, St. Kilda, Vic.**

WANTED: Copy Radio and Hobbies, Vol. 1, No. 2. Price and particulars to **A. S. Moye, Box 72, P.O., Wagga Wagga.**

WANTED to buy second-hand 24-volt D.C. electric fan in good order. **W. H. Stacey, Mount Perry, Queensland.**

WANTED to buy: Recent back numbers radio magazines—QST Radio, Radio-craft, etc.; good prices paid; also book "Automatic Frequency Control Systems," by Rider. Write **F. Browne, Box 101, Warrnambool, Victoria.**

WANTED: 8mm. projector, cheap, for boys on active service. **S36276, Pte. A. L. Beck, 10th Aus. C.C.S., Australia.**

WANTED to buy: Radio and Hobbies for August, 1942. **H. A. Kellahan, Eglinton P.O., via Bathurst.**

FOR SALE: 2v. accumulator, 19 1D4 valves, 4 audio transformers, 1 2-gang condensers, also several other types, 1 3-gang wave-change switch, 1 5-m.a. Westinghouse dry rectifier. Wanted a crystal mike. **R. Argue, 23 Mount-street, Ancliffe.**

SALE or Exchange: AK2, AL3, AF3, AZ3, ABC1, 12Z3, 43, 1K6, 15 type valves, unused. Single to four gang condensers. 2, 4 and 6 volt battery valves, used, all types. Wanted, Volt-ohm meter or multimeter, and A.C. oscillator. **C. F. Graves, Ringarooma, Tasmania.**

FOR SALE—Valves, 1C6, 30, 32 and 2 type 34, 6/6 each; 31 back numbers of "Radio and Hobbies." Write to **A. Brodbeck, 9 Tempest-st., Gunnedah.**

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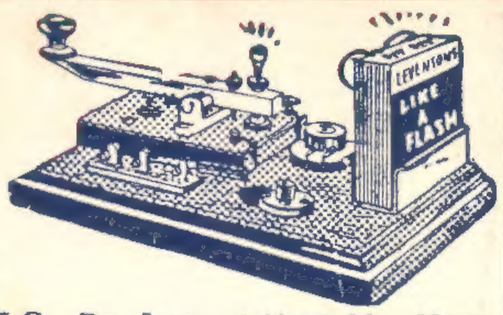
HINTS FOR THE HOME HANDYMAN

MISCELLANEOUS

HOME WORKSHOP

...e Key ...zzer. ...d.



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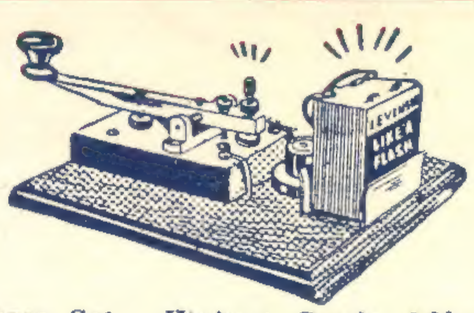

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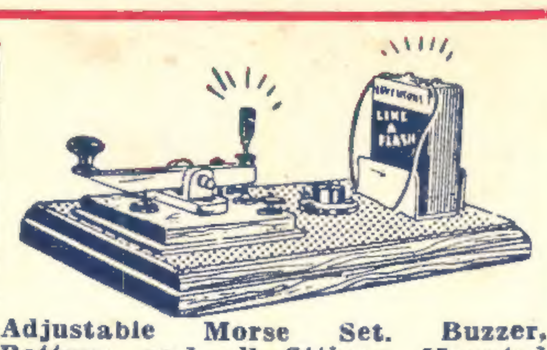

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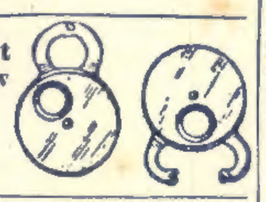

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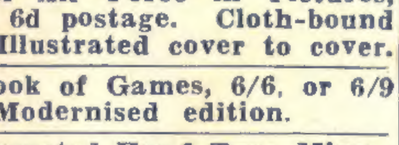

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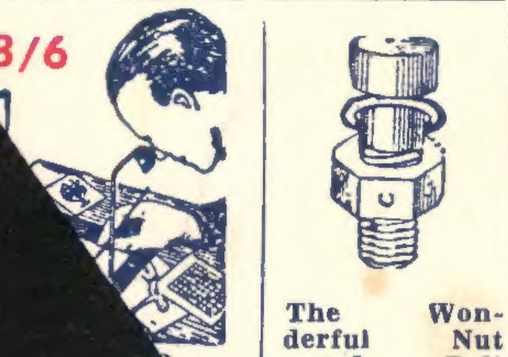

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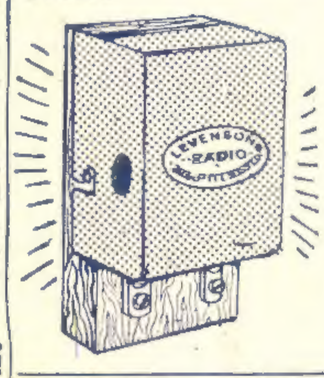

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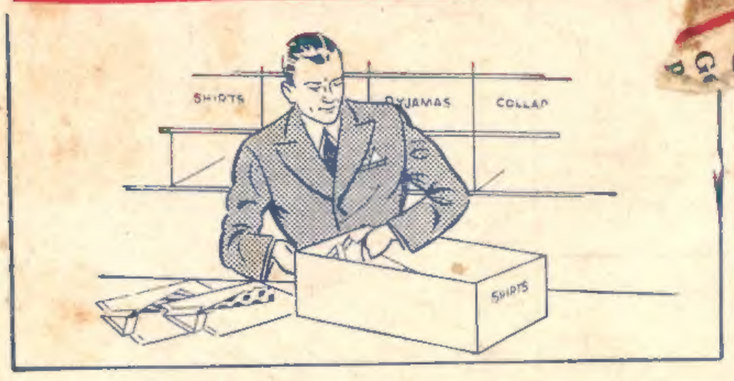

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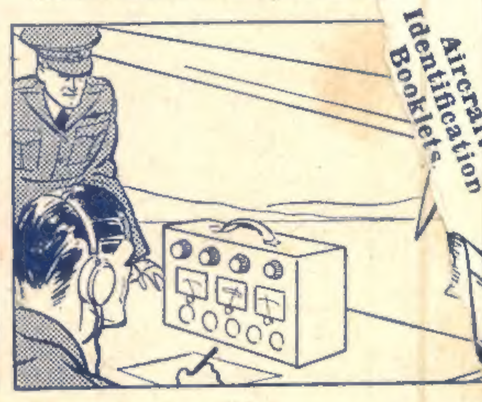

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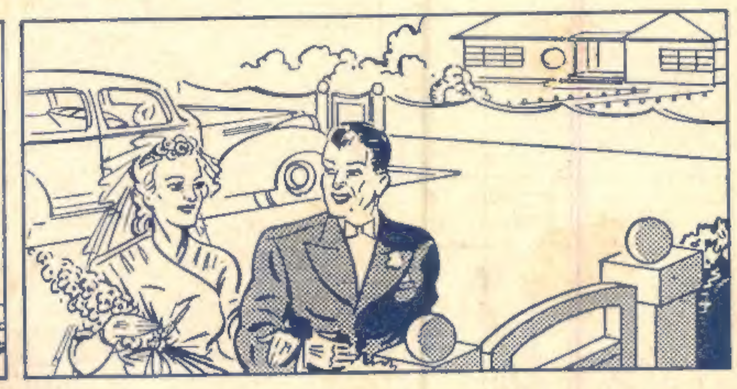

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